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MARCH 1940

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Among Our Writers

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Justin R. Hartzog (Cornell and Denison U.) in 1918 was assistant to Chief of Construction Division of the Army. Since then he has occupied positions of increasing importance in the field of city and district planning, including the post of state planning consultant for the National Resources Planning Board in Rhode Island and New Hampshire, and city planning consultant for the U.S. Housing Authority. He is also visiting critic in city planning at M.I.T.

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Volume 10 Number 3

March 1940

Entered as second class matter September 23, 1930, at the Post Office at Easton, Pa., under the Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

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CIVIL ENGINEERING

Published Monthly by the

American Society of Civil Engineers

(*Founded November 5, 1852*)

Publication Office: 20th and Northampton Streets, Easton,

Editorial and Advertising Departments:

33 West 39th Street, New York

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Subscription Rates

Price, 50 cents a copy; $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents and foreign postage $1.50 additional.

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Something to Think About

A Series of Reflective Comments Sponsored by the Committee on Publications

Shall We Teach Culture?

By N. W. Dougherty

Member American Society of Civil Engineers

Assistant Dean of Engineering, The University of Tennessee, Knoxville, Tenn.

ENGINEERS are seeking a liberal education or culture. They have not defined the object of their search sufficiently to speak a common language; some say "Lo here!"; others say "Lo, there!" And all say, "Let us seek it."

No doubt this attitude has come about because of the great variety of men who call themselves engineers: some wear overalls, some sit in the halls of learning, others have reached fame in industry. Many of them are rough men given to doing rather than to saying—men who are at home among wheels, who fear not the lightning, who achieve wonders in materials, but who are embarrassed by social ideas and abstract expression.

What the Engineer Needs.~They can manufacture steel, mix concrete, construct skyscrapers, design dynamos, install turbines, transmit speech, transform materials, transmute chemicals—and never break their stride. They can produce goods, convey commodities, conquer the air with the wings of the morning, mine into the earth, tap sources of energy stored by the sun for future generations; they can speak fluently in their own jargon, but they become panicky at a few phrases from Shakespeare. They need a liberal education.

Some of them need to have it wrapped in packages and served in vending machines; others try to find it in books (and the liberal arts educator has run away with the keys); still others think it is to be found in the museum, the art gallery, or the music shop.

At first the engineer was so interested in what he was doing that he did not care what he was saying. His work brought him in contact with all kinds of people, some boors, some refined. And then began his desire to be identified with the refined and distinguished from the coarse. This he thought would come by worship at the shrine of culture.

A More General Education.~In this engineering is not greatly different from other professions. All are seeking something in addition to their prescribed minimum training in professional subjects. Their search is only beginning because professional demands will become more insistent as the fields of knowledge grow and the need for basic science increases and as their field of activity, though specialized, impinges upon many avenues of life.

General education is becoming an essential for all who assume leadership in public life. All the professions are coming into contact with the public and it seems that we are in the initial stages of public employment for professional men. Certainly increasing public demands are being made upon them. All the professions have some form of licensure to protect the public against the faker, the charlatan, the shyster, and the incompetent, by requiring that only those with accepted minimum qualifications may call themselves by professional titles. There is definitely a movement to socialize the professions. More than 60 per cent of the civil engineering group are employed by the public; other engineers, though they are resisting, are being inducted into public service. Doctors and dentists are obstructing it now, but socialized medicine and dentistry are nearer than the distant future. Preachers and teachers have worked for the public so long that they think it has always been so.

These trends are making the engineer conscious of the need for knowledge of human relations, the need for training in government, the desire for participation in government itself. The demand for formal training in human relations is inevitable; it will come, and for many it is already here.

Choice of Action.~What are we trying to find when we seek culture? Is its essence "voluntary disinterestedness," something divorced from the useful, something that is ornamental, something that gives polish to actions and thoughts?

The old Jewish prophet realized that there were at least two conflicting attitudes toward life which would be at battle for many generations to come. He said: "Thy sons, O Zion, against thy sons, O Greece." The prophets and sages of these two countries have played leading roles in the culture of the race. We cannot agree on one or two words which express the contribution of each but certainly they knew a never-ending battle was raging between self-denial, sacrifice, living by rules, on the one hand; and self-expression, enjoyment, and freedom of action on the other. The one thought and taught the straight hard path of duty, saying "The greatest among you is the servant"; the other advocated the doctrine of the mean, the balanced life, the pathway between extremes. Be not a glutton, or an ascetic, be

temperate, it said. Be not a coward or foolhardy; be brave. Be not stingy, or a spendthrift; be generous or munificent. These paths have some things in common but they start at different poles and arrive at widely separated goals.

Our culture is an odd mixture of both—not a mixing of oil and water but a blending of wine with sorrow, a compounding of temperance with service; a weighting of the balloon of imagination with the practical ballast of accomplishment. We sit at the feast of the Eucharist, with a joyful song in celebration of one of the greatest tragedies of the human race, and detect no inconsistency. Our priests and prophets assure us that piety, goodness, sobriety, and general temperance are not enough; we need self-sacrifice and some form of vicarious atonement. There is little in American life of seeking knowledge, excellence, or virtue, unless knowledge can be used, excellence be capitalized, and virtue be rewarded.

Attempting to Delimit Culture.—Engineers are wont to express the belief that culture is bounded by the walls of the liberal arts college. No branch of human knowledge has a corner on culture or liberal training. No series of courses, without reference to the way they are taught or studied, have cultural value. Culture is acquired by the method of study, the spirit of approach, and not by the kind of knowledge.

We associate culture with writing and reading poetry and think of it as being foreign to plumbing or mixing concrete. Normally these associations are true but we can think of a verse-maker whose mind savors of the sewer, and we can think of a concrete-maker who is building a cathedral.

For generations we have associated culture with a knowledge of Latin and Greek. Time was when the cultured few knew these languages; they were the tools and the open sesame to the knowledge of the day. There was no other approach. Was it the vehicle that made the culture, or was it the cargo carried by the vehicle, or the dexterity with which the vehicle was used?

Hunger for Truth.—Is liberal education a program of study, or a method of study? Is culture a kind of knowledge, or an attitude of mind? Does broad general training consist of useful things or ornamental shrubbery and flowers which cause the mind to bloom in spring, bear fruit in middle age, and grow old gracefully?

Can these things be taught? Our answer is "yes," but not in regular assignments and by examination. They can only be taught by those who possess them, and then by contact, association, contagion, and as by-products and incidentals rather than formal study. Any subject taught by a master has possibilities.

Any teaching which instills in students a desire to know more and inspires them with a willingness to exert real effort to acquire greater knowledge and understanding, is bordering on culture. The desire may be tainted with selfishness and still have the leaven in it. If it be a disinterested hungering and thirsting for truth, the seeker will be filled and he will know the truth and the truth will make him free.

Spirit of Liberal Training.—Freedom is a prime requisite of liberal education and culture. It is the voluntary effort, the undemanded service, the unresisted leading, the "second mile," that pays dividends in culture. It is not fine manners, it is not polished speech, it is not this course or that; it is a spirit, an attitude, an approach, a method, a living thing which has fine manners, polished speech, and a human understanding. It is free from fads, and styles; it is not put up in fancy packages, with high-sounding labels; it is not confined to poetry or to art galleries. "Wherever there is good breeding, gentle tastes, manly delicacy, openness and activity of mind, intellectual interest, and a sense of public duty," there will be found the object of our search.

You will say that we have only threshed over old straw. We claim nothing new or original, but repeat the motif of Russell Conwell's "Acres of Diamonds." After searching all over the world for riches the traveler returned to his home, which he had sold before starting the search, and there he found, not the old homestead, but workers mining acres of diamonds.

An Essential Philosophy of Teaching.—Engineers must have what the liberal arts college has to give, not as liberal education or culture per se, but as a part of their professional education, because where there is an element of disinterestedness, boundless limits to educational possibilities, and contact with human relations, laws of nature, and proficiency in expression, there is real possibility for acquiring liberal culture. Because the professions need certain kinds of knowledge and mental disciplines there is no reason to think they cannot worship at the shrine.

Some day—not until we children of the old school have passed away—some person with a knowledge of engineering, the imagination of an artist, and the vocabulary of a poet will express the cultural value to be found in applied science, engineering principles, and a technology that has revolutionized our everyday living. He will make a distinction between things and ideas; he will point to the difference between information and learning; and he will distinguish between the parrot-like repetition of authority and the deep flowing stream of intellectual integrity. He will find universal laws, common methods, and the same final result. He will conclude that the warp and woof of all knowledge stems from a common thread, but the different patterns show the handiwork of many skilled workers.

A Learning That Discriminates.—Let us emphasize the need for teachers who can cause students to leave their classes with a hungering and thirsting after more knowledge, more understanding, and a desire for more humility and less prejudice and self-satisfaction. If any teacher, no matter what he teaches, can inspire students to continue intellectual activity after college training is over, that teacher has contributed to a liberal education.

Americans have fallen into the snare and the delusion that all learning must come during the formal schooling period, and that if subjects are not introduced somewhere in the organized curriculum they will be hidden for all time. Of this attitude is begotten the saying, "I have graduated from college. Thank God, I don't have to study any more." A student who believes that his period of study is over is doomed to ignorance and barbarism. If he knows that his studying days have just begun and that he has acquired an intellectual appetite which discriminates, he will be on the road leading to a liberal education and possibly ultimately to culture.

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CIVIL ENGINEERING

MARCH 1940

VOLUME 10

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NUMBER 3

Construction Progress on the Pennsylvania Turnpike

FROM AN ADDRESS BEFORE THE METROPOLITAN SECTION

By J. K. KNOERLE
ASSOCIATE MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
PROJECT ENGINEER, J. E. GREINER COMPANY, CONSULTING ENGINEERS, BALTIMORE, MD.

A DESCRIPTION of the progress made, and the equipment and methods in use on the 160-mile Pennsylvania Turnpike, now under construction between Harrisburg and Pittsburgh, Pa., is here given by Mr. Knoerle. In the February issue, Herschel H. Allen, M. Am. Soc. C.E., gave a review of the history of the project and discussed some of its outstanding features.

IN view of the short time allocated to substantially complete the Pennsylvania Turnpike—up to June 30, 1940—the Pennsylvania Turnpike Commission established a completion schedule for surveys, plans, and contracts which required the greatest speed and cooperation on the part of all agencies involved. All phases of the work were divided up into small separate contracts in order that each section could be put under contract just as soon as a set of plans and specifications was completed. Such a procedure required a large personnel and large quantities of construction equipment, but the results so far show that the schedule has been adhered to. All work has been going ahead at high speed for the past year, and at the present time about 80 contracts have been awarded, covering all grading, structures, tunnels, paving, and portal buildings. Of these, about 20 contracts, representing over 93% of the grading and structures, have been completed. There are to be about 20 more contracts covering electrical work, guard rail, fencing, signs, ticket stations, maintenance equipment, and miscellaneous items. All carry a completion date prior to June 30, 1940.

The Commission is directing the field work through four division offices located at strategic points along the turnpike, with administrative offices in Harrisburg. During the peak of the construction season, over 1,400 persons were employed, including legal and right-of-way divisions, and administrative and engineering departments. The engineering personnel formed the largest group, amounting to over 1,100. This large number was made necessary by the fact that all operations were carried on both day and night, and construction work was in progress at the same time that surveys, plans, and specifications were being prepared for future contracts.

It was necessary to get the grading contracts under way as soon as possible, in order that all fills might be completed before the winter of 1939–1940. Otherwise there would not be sufficient time for settlement to take place before paving operations start in the spring of 1940. The first grading contract was commenced in November 1938 and the last was awarded in August 1939. These contracts also included the large bridges and drainage and grade-separation structures.

As an example of the fast schedule called for, Contract No. 29, Franklin County, involved 9.54 miles of grading and 19 structures for a total contract price of $731,466, with a contract time of only 120 calendar days. To complete contracts of this size in so short a time required a large and diversified amount of construction equipment, capable of standing up under the severe conditions imposed by operation 24 hours a day.

Most of the material to be excavated consisted of various types of solid and loose rock and shales. As the grading sections were long, equipment suitable for hauling large quantities for long distances was required. In the heavy rock cuts, Diesel-operated shovels were universally used. There were over 200 of these modern power shovels in use on the various contracts in sizes from $\frac{1}{2}$ to $2\frac{1}{2}$ cu yd. It is interesting to note that there were only two steam-operated shovels on the entire turnpike. Material was hauled away from the shovels with various types of equipment, including pneumatic-tired trucks, tractors and wagons, side-dump wagons and one-man

TYPICAL BARREL-ARCH DRAINAGE STRUCTURE UNDER ONE OF THE HIGH FILLS

SELF-LOADING SCRAPERS AT WORK IN SOMERSET COUNTY

dumpsters. In many locations, shales and clays were encountered, in which self-loading scrapers could be readily employed, and this type of equipment proved very efficient and economical for the long hauls. These scrapers, pulled with Diesel tractors, varied in size from 5 to 30 cu yd, the latter being the largest ever used on a grading project. There were over 225 of these units in operation at one time on all the grading contracts.

HEAVY BLASTING OPERATIONS INVOLVED

Blasting operations involved enormous yardages. The cuts in general were large enough so that they could be divided into sections and the loosened material removed from one end of the cut, while the other end was being drilled and loaded. Gangs of rubber-tired wagon drills were used, the holes being made with $2^3/_4$-in. tapered drills. The spacing was about 6 ft on centers, and the depth from 15 to 25 ft. On the heavy cuts, 440-cu ft compressors were used. Some of the charges were the heaviest ever set off on highway work. As an example, one charge on Contract No. 9, Bedford County, consisted of 2,070 holes, 24 ft deep, and $5^1/_2$ ft on centers. A total of 42,700 lb of 40% dynamite—the equivalent of $2^1/_8$ freight-car loads—was used for the charge. Three portable light plants were required to explode the caps, and approximately 50,000 cu yd of rock was loosened.

As the fills were to be paved within a short time after their construction, it was necessary to compact and roll them thoroughly. The specifications require that all but rock fills be made in layers 8 in. thick, uniformly spread and rolled. This requirement was rigidly enforced with the result that very little settlement has been recorded even on the highest shale and earth fills. The heavy rock fills are made in uniform rolled layers up to 2 ft thick, but the rock is first broken in smaller pieces with skull crackers, mud capping, and sledges. This requirement made necessary the use of many power rollers, bulldozers, and graders, to spread and compact the fill material.

Operations were carried on at night, the year round, on all contracts. The fills were lined with floodlights and all excavating and hauling equipment was supplied with searchlights. In most cases, the power was furnished by portable electric light plants. One inspector was assigned to each fill, both day and night.

All contractors were well supplied with ample reserve equipment so that operations were never delayed. The following list of equipment, used on Contract No. 34, gives an idea of the large amount and diversified character of the units provided on an average contract: 7 power shovels, $^3/_8$ to 2 cu yd; 2 power cranes, $1^1/_2$ cu yd; 1 power back hoe, $^3/_8$ cu yd; 1 tractor truck, 10 cu yd; three 10-ton end-dump trucks; six 5-ton end-dump trucks; one $1^1/_2$-cu yd truck, 2 concrete mixers; 8 tractors and self-loading scrapers, 12 cu yd; 10 tractors and self-loading scrapers, 10 cu yd; 9 tractors and bulldozers; two 12-ft motor graders, five 310-ft compressors; three 10-ton rollers; one 12-ton roller; one rooter; six 3-cu yd wagons; and one service car—a total of 69 major pieces of equipment.

Such assemblages of equipment, multiplied many times over and costing many millions of dollars, resulted in the moving of approximately 24,000,000 cu yd of excavation in a little over one year's time. The average price for unclassified excavation, "Class 1," on the 37 grading contracts, exclusive of tunnel approaches, was $0.418 per cu yd, which is relatively low considering the large amount of rock encountered. The class of material did not seem to affect production, as one contractor moved 460,000 cu yd of excavation in one month, which was a record.

1,150,000 CUBIC YARDS IN ONE CUT

In providing the maximum 3% grade on the turnpike, it was found necessary to cross many of the smaller ridges with deep cuts in order to eliminate the need for additional tunnels. As a result the heaviest cut, at Clear Ridge, is 2,475 ft in length and contains 1,150,000 cu yd of material—mostly rock. It is to be 153 ft deep at the highest point, and the sides are terraced for drainage. Many other cuts contained over 200,000 cu yd each and many of the fills were 40 ft deep, the highest being 90 ft. One side-hill cut near Everett is about 200 ft high. A large quantity of shovels and hauling equipment was required in order that these heavy cuts might be prosecuted at the same time as the lighter cuts and fills on the same contracts. It was always imperative to complete structures in advance under these heavy fills, in order to eliminate gaps that would have to be filled in later. In the western section of the turnpike, difficult construction was encountered at the location of old coal mines. In some places, it was necessary to remove volumes of material for a length of several hundred feet and a depth of 35 ft below the finished grade, in order to uncover coal seams and mine drifts. After removing the coal, these areas were carefully backfilled with rolled layers of firm material, as a precautionary measure to prevent danger from mine fires and settlements in the old drifts.

As previously stated, all structures are included in the grading contracts. This avoids division of responsibility, and makes it impossible for the non-completion of a structure to hold up the making of a fill. In some cases, structures formed the major part of a contract. The large number of streams and highways crossed required about 300 major crossings in addition to hundreds of smaller drainage structures. Most of the bridges were completed

ANOTHER TYPE OF HAULING EQUIPMENT

by December 1939. Progress on one of the major structures, the New Stanton Viaduct, is typical of the speed attained. This bridge, which is on a grade and superelevated curve, consists of a three-rib open-spandrel arch with a 170-ft main span, flanked on each end with a three-span, continuous, ribbed-type rigid frame, making

ONE OF THE SIX OLD RAILROAD TUNNELS NOW BEING ENLARGED
Timber Supports Placed 50 Years Ago Were Found Excellently Preserved

a total length of 600 ft. It was designed by the engineers of the Turnpike Commission and built complete in 7 months from the start of the design. As the contractor was allowed only 160 calendar days for the work, he used timber falsework under all three ribs at the same time to avoid delay due to shifting centering from one rib to another. Both end sections were also constructed at the same time, adding still more to the amount of falsework required. All work was prosecuted night and day.

CONSTRUCTION OF RIGID-FRAME BRIDGES

Many of the crossings over the turnpike were reinforced concrete rigid frames with a 78-ft clear span for the 90° crossings and longer spans for skew crossings up to 30°. Though most of the contractors had never built a rigid frame before, surprising speed and quality of workmanship was attained. Plenty of local timber was available for falsework. Heavy plywood was generally used for forms instead of tongue-and-groove sheeting. Most of the concrete was hauled to the bridges in mixer trucks from batch plants located at the railroad sidings or quarry, and hoisted direct to the forms in bottom-dump buckets handled by crawler cranes. Portable gasoline-driven vibrators were used internally, and little difficulty was encountered in pouring. The quality of workmanship proves that the rigid frame can be built by the average contractor without difficulty. These structures present a very pleasing appearance in their rustic setting. They were built at very low cost and should also prove to be low in maintenance cost.

In some localities plate girders were used for the long skew crossings. These girders were hauled for distances of 12 to 15 miles over the mountain highways. The largest was 132 ft long and weighed 52 tons.

The Commission maintained a very efficient corps of inspectors and testing engineers to cover the construction of all structures. Because of the length and size of the turnpike project, many sources of material were sampled and tested. A complete force of geologists and special bridge engineers went from site to site to render immediate reports on the various foundations encountered in order to pass on and expedite changes where required by foundation conditions.

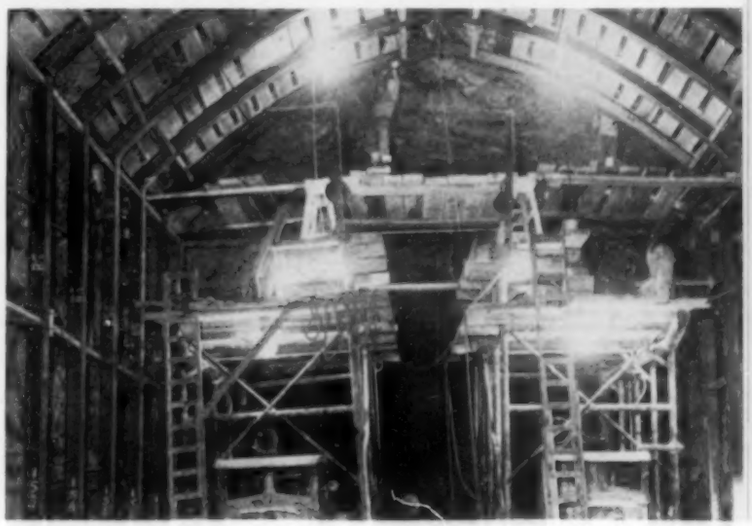
Construction of the seven tunnels is being carried on simultaneously by six different contractors. A considerable portion of all the tunnels, except the one through Allegheny Mountain, had been previously driven from both headings for single and double-track widths during the construction work on the Old South Penn Railroad over fifty years ago. Allegheny Tunnel is parallel to and south of the old tunnel, which was not used because of dangerous rock conditions.

OLD AND NEW TUNNELING METHODS CONTRASTED

A review of the progress reports made during the construction of the old tunnels is of interest as a basis for comparison with present progress and methods. The bench-and-heading system then in common use was employed. Excavation was carried on by hand, but the drills were mechanically powered. Forty per cent dynamite was used. The average progress was from 5 to 7 ft every 24 hours. The roof was supported with accurately cut timbers. Reports indicate that most of the trouble encountered was due to lack of drilling power as the work progressed.

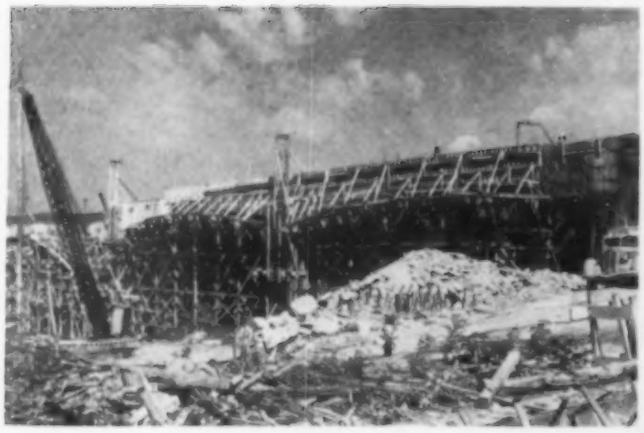
On the present project, the contractors have erected the most modern and fully equipped power plants, mixer plants, and material yards. At the beginning of operations, all the tunnels had to be widened out to full section in the previously driven areas. This required roof and side scaling operations in all cases. Jumbos were erected on ordinary truck chassis, and in many cases the roof scaling was done from platforms erected on top of the shovels. Progress varied owing to dangerous falls in the old tunnels, which had to be braced as the work progressed. Steel arch beams of 7- and 8-in. size are being used to support the tunnel roof and protect the workmen. They are placed immediately behind the excavating equipment, and are supported on steel columns, since the tunnel side walls are not sufficiently strong to support them on hitches. These beams are spaced from 2 ft 6 in. to 7 ft on centers, depending on the nature of the roof loads. The space between their flanges is filled with timber lagging, and the beams and columns are bolted together with tie rods. After the roof supports are placed, many of the high falls are braced with timbers and the voids backfilled with stone packing. Fortunately, most of the excavation has been done during the fall and winter months, and therefore very little water has been encountered.

At present, all the contractors have completed widening operations in the previously driven areas and are now operating full-face headings from both ends of each



PLACING STEEL SUPPORTS FROM TRUCK JUMBOS IN SIDELING HILL TUNNEL

At Work on Tunnels and Bridges, Cuts and Fills



NEW STANTON VIADUCT—A 600-FT BRIDGE BUILT IN 160 DAYS
With No Time to Shift Centering, Extra Falsework Was Required

REMOVING AN OLD COAL MINE, 35 FT BELOW THE TURNPIKE GRADE

CONCRETE PLANT AND YARD BETWEEN BLUE AND KITTITINNY TUNNELS

THE LARGEST SCRAPER—CAPACITY, 30 CU YD

A TYPICAL GRADING VIEW, SHOWING THE DIVERSIFIED EQUIPMENT
Note the Floodlights for Night Work

PLACING ROOF STEEL FROM JUMBO IN RAYS HILL TUNNEL
In Foreground, a One-Man Dumpster Used for Mucking

tunnel. Two drill carriages, each carrying 6 or 7 drills mounted on pipes, are used. After drilling and shooting, these carriages, usually mounted on trucks, are shunted back to one side of the tunnel, and mucking operations begin. The use of $1^1/_2$-cu yd electric shovels predominates; these are moved up into place to load the muck on industrial railway cars, Diesel trucks, or one-man dumpsters. A short distance behind, an arched jumbo is pulled into place and the steel roof beams are set. Rays Hill Tunnel has already been holed through, and the others will follow at intervals of a few weeks. Progress in the various headings varies from 10 to 22 ft a day, the average being about 17 ft. Excavation in the normal cross section calls for the removal of 28 cu yd of material per foot of tunnel.

Ventilation requirements are quite severe, and fresh air is being supplied to the headings by electrically driven centrifugal fans. In the Sideling Hill Tunnel, air is being forced through the permanent concrete center drainage gallery, which is installed as the excavation proceeds. In the Allegheny Tunnel, collapsible canvas tubes are used for ventilation purposes, and in all the other tunnels steel pipe is used.

Concreting must necessarily follow very closely behind the excavating, and in order to provide a dependable supply of concrete when required, all the contractors have erected complete mixing and batching plants, with standby equipment. (For the Laurel Hill Tunnel, because of its isolated location, the contractor found it necessary to open up a quarry and install a rock crushing and screening plant for coarse aggregate.) The concrete tunnel lining is 18 in. in thickness and encases the steel arch ribs and columns. Collapsible steel concrete forms, furnished in three sections, are used. The first section, or side-wall form, is 30 ft long and is used in pouring the concrete up to the springing line of the arch. These forms are stripped after 10 hours, thereby making it possible to concrete 30 ft of side wall each 24 hours. The second form is for the arch and the third is for the roof of the tunnel, which forms the ventilation duct. In several of the tunnels, concrete is brought in by industrial railway and the tracks are so arranged as not to interfere with mucking operations. In the Sideling Hill Tunnel, the concrete is brought in by mixer trucks. Both pneumatic and pump equipment are used to force the concrete into the forms.

The portal buildings to house the ventilation equipment are being constructed under separate contracts without interference with the tunnel contractors. Contracts require that work on these structures shall continue through the winter months, and the cold weather encountered in the mountains necessitates the use of extensive coverings and steam heat.

PAVING SCHEDULE CALLS FOR 40,000 TONS OF MATERIALS PER DAY

Outside of the tunnels, there is about 153 miles of four-lane reinforced concrete pavement. Each lane is 12 ft wide and has a uniform thickness of 9 in. The paving has been divided into 28 contracts, which also includes the interchanges. These sections vary from 1 to 10 miles in length, with an average of $5^1/_2$ miles per contract. About 13 miles of slab was laid in the fall of 1939 before winter weather set in, leaving 140 miles to be completed in the spring, on an average schedule of about $3^1/_2$ miles per day. To maintain this rate will require the transportation of an enormous quantity of materials. It is estimated that over one thousand 40-ton freight cars of material will be needed daily. In preparation for this demand, most of the contractors are stockpiling fine and coarse aggregates during the winter months.

Specifications require the use of dual mixers. Most of the contractors are using mixers with a capacity of $1^1/_4$ cu yd, which are able to lay about 76 cu yd an hour—the equivalent of 228 lin ft of 12-ft slab. Some of the contractors plan to use two mixers, one for placing the first course, and the second to follow with the top course above the reinforcing steel. Water is supplied to the mixers by tank trucks instead of pipe lines. The latest types of subgraders and mechanical form tampers are being employed. Screw spreaders and consolidating machines and mechanically operated longitudinal floats supplement the double screeds, giving an unusually smooth riding surface.

Expansion joints are placed 77 ft on centers and have been held to a maximum thickness of one inch. Portable gasoline vibrators consolidate the concrete around them. Special care has been taken to obtain good joints, with the result that they cannot be felt by the motorist as he passes over them. Holes have been placed in the reinforced slab adjacent to all bridge abutments to provide for subgrade maintenance, in case of fill settlement.

The concrete is cured for 72 hours—usually under wet burlap mats, though some contractors have preferred to use heavy asphalt-impregnated paper. On cold nights in the fall, supplemental coverings of straw were employed. The last paving in 1939 was laid on November 23, in Cumberland County. Paving will be resumed in the spring as soon as subgrade conditions permit.

In the design and construction of the turnpike, the aim throughout has been permanence with a minimum of maintenance costs. Besides being attractive and safe for high speeds, this highway should prove that high-class construction pays in the long run, particularly on a to llroute of this type where traffic delays due to maintenance problems would be serious.

The Turnpike Commission is headed by Walter A. Jones, chairman, with Samuel W. Marshall as chief engineer; Roger B. Stone, construction engineer; R. M. Merriman, chief tunnel engineer; H. L. Lundy, division engineer at Shippensburg; Samuel W. Nowell, division engineer at Everett; Bowie G. Etchison, division engineer at Somerset; and George Chapman, division engineer at Mount Pleasant. James F. Murphy is project engineer for the PWA, and Col. F. E. Lamphere is inspecting engineer for the RFC.

TURNPIKE FACTS

Major Quantities

Excavation and borrow	24,600,000 cu yd
Steel in structures and reinforced pavement	30,000 tons
Concrete pavement	4,300,000 sq yd
Concrete in structures	280,000 cu yd
Tunnel excavation	770,000 cu yd
Tunnel concrete	245,000 cu yd
Tunnel steel	19,000 tons

Major Divisions of Construction Costs

Grading	$10,500,000
Structures	10,000,000
Tunnels complete including buildings	15,000,000
Paving	15,000,000
Ticket stations, maintenance equipment, guard rail, and miscellaneous	2,500,000

Average Unit Costs

Excavation, including tunnel approaches	$ 0.434
Structural concrete, Class A	21.78
Structural concrete, Class B	17.95
Reinforcing steel	0.045
Structural steel	0.039
Grading and structures per mile of turnpike	133,000.00
Paving per mile of turnpike	97,000.00
Bare tunnels per lin ft, not including portals and equipment	363.00

The City Planner's Responsibility in the Preparedness Program

By JUSTIN R. HARTZOG, M. AM. SOC. C.E.
CITY PLANNING CONSULTANT, CAMBRIDGE, MASS.

FOR the theme of its session at the 1940 Annual Meeting, the City Planning Division chose "community planning measures to be undertaken during neutrality as part of a preparedness program." The opening paper, by Mr. Hartzog, is presented here in slightly abridged form. In it he emphasizes that the present effort to perfect a national preparedness program gives the community planner a new and important rôle. The local planning measures that now have a relationship to the program are listed, as well as the additional measures that will be needed to assist in the full effectuation of the program.

IN a sense all city planning is in the nature of a preparedness program, but its final results of course differ radically from those of a military preparedness program. In the case of city planning we hope for the full fruition of our plans because of their benefit to mankind, whereas in the military program we hope fervently that the plans and the early stages of their execution will be so effective as to discourage any would-be attacker from ever putting them to the final test.

We should like to get along without the great expense of a military machine—and we probably do, to a greater extent than any other nation—but our example seems rarely to be contagious. In past wars lack of planning and basic implementation has been one of our greatest shortcomings. Fortunately these warnings have been heeded, and a preparedness program has been under way for a considerable period of years since the World War. This "Preparedness Program" is essentially protective planning, growing out of our defense attitude of mind. As such, its basic principle is the preservation of the general welfare of the people of this country, and not the discomfiture of people of other nations.

A SPECIALIZED FOFM OF NATIONAL PLANNING

Preparedness planning is a specialized form of national planning. True, its major aim is the maintenance of the "status quo," since we do not hope to profit physically, economically, or socially by any war. This planning is national planning not only geographically, but industrially, commercially, and agriculturally. It is highly purposeful, direct, and all-inclusive. Each community and rural area, and each man and woman will be important units in the program.

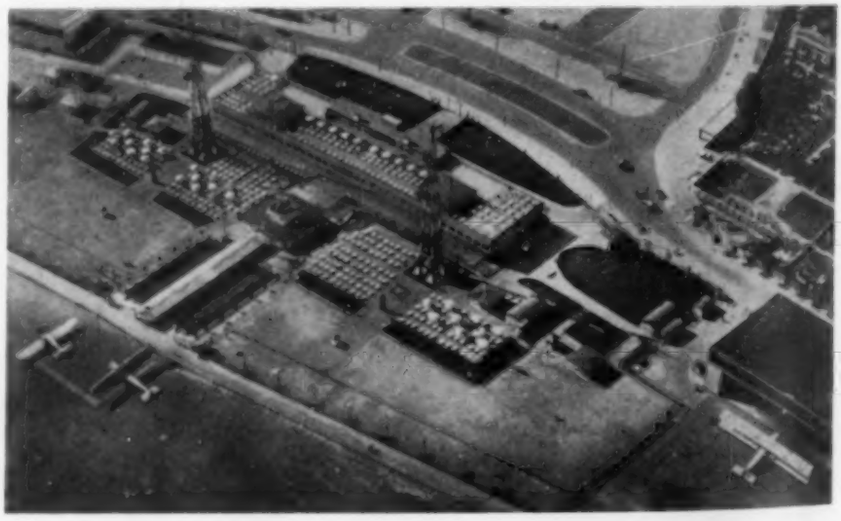
Bismarck is said to have complained after 1870 that "wars are no longer fought between cabinets," that the people had to be considered in the future if war were to be "animated with impetus and fire." Nowadays the people of the world do not seem to want to fight one another. Yet some leaders still seem to be able to confuse the public mind to the extent that wars still recur. Supreme efforts go into the nullification of the growth of the people's ideals, and much wealth is lost which is only too sadly needed, the world over, to alleviate human suffering and substandard living. So the old adage remains, "Fight fire with fire."

While adverse to war, we are not weak-kneed about it. While sympathetic to peace, we should not hesitate to plan to meet war, and should all efforts fail to prevent involvement, we should be equipped to strike hard. This all suggests protective planning with an insight and thoroughness never before contemplated.

The city planner can assume large responsibilities in protective planning. We refer to him not as an individual citizen, though as such he may be highly effective, but rather in his professional relation to the community. Professionally he is a creator, an anticipator, a coordinator, a natural surveyor, and a friend of man. His job is to see beyond obstacles, to work toward comprehensive accomplishment, and to bring other specialists into joint purposeful action, all for the public good.

It is the comprehensive ideal of a balanced community life which normally should bring his activity into close contact with the preparedness program, to make protective planning effective without letting the intensiveness of the program thwart the community program. He should not be a salvager, but rather a coordinator.

It is still more important in a time of stress and strain, such as a period of wary neutrality, that there should be a continuation of community planning for the general welfare, as a balance wheel of "status quo" planning, or as an antidote for the destructive processes that will prevail if neutrality fails and a "war plan" is put to the test. In this latter event it can be the means of assisting materially in the maintenance of public morale.



TEMPELHOF AIRDROME, BERLIN, GERMANY—ONE OF THE BEST LOCATED AND DEVELOPED COMMERCIAL AIRPORTS

The nation's preparedness program may be assumed to concern itself with three general forms of action: (1) military mobilization and training, (2) industrial mobilization and utilization of economic resources; and (3) public spirit. The planning for (1) is a function of the command sides of the War and Navy Departments, and will not be discussed. It is with (2) and (3) that the city planner is chiefly concerned.

TYPICAL OF THE DECENTRALIZATION OF INDUSTRY IS THE TENNESSEE EASTMAN COMPANY PLANT AT KINGSPORT, TENN.

PREPAREDNESS PROGRAM FOR DEFENSE OUTLINED

The preparedness program referred to here is outlined in the Industrial Mobilization Plan (Revision of 1939). In this document the current problem relating to defensive structure is stated as follows:

"The War and Navy Departments, under authority of the Congress, have the responsibility of building up a defensive structure which will make hostile attack improbable. Under legislative mandate the armed services must prepare plans for industrial mobilization supporting the military effort, and looking toward early and complete victory. Such plans should attempt to avert those preventable evils which have made their appearance in past wars.

"The task is not simple. To make arrangements for the effective use of material resources in war, the plans evolved must consider the problems of the Army, the Navy, the civilian population, and industry. These plans must receive the approval of the President, and of Congress. Frequent revision, based upon constant study and research, are essential in order to adapt such plans to changing economic and political conditions. [Note: Revisions have been made in 1933, 1936, and 1939.]

"Fundamentally, the first step in the preparation of a sound plan for industrial mobilization is the determination of the material requirements of the Army and Navy. Requirements must be estimated independently by the two armed services, guided by the general policies laid down by the Army and Navy Joint Board. [Note: The principal field of the Army and Navy Joint Board is that of military policy and the strategic aspects of war planning.]

"Actual requirements of munitions for any given situation must be compared with the nation's stocks on hand and available capacity for production. In the determination of the nation's ability to meet the war load, due allowance must be made for the essential needs of governmental agencies other than the War and Navy Departments, and the civilian population. Plans can then be developed under which our resources may be utilized to fulfil national requirements, and specific plans may be prepared for the procurement of those items considered essential.

"Upon completion of the steps outlined above, the preparation of plans may be undertaken to assist industry in absorbing the war load, and for appropriate administrative bodies to carry out these measures.

"Since the actual execution of any industrial mobilization plan must be undertaken by civilian leaders, under conditions which cannot be predicated exactly, the plan must be flexible in its provisions. The essential parts of the general plan, however, must be outlined clearly, in order that the relationships visualized among the various agencies proposed may be clearly understood.

"All the aforementioned factors have been considered in the preparation of the various provisions of the plan . . . in the hope that in time of a major emergency the procedure outlined will facilitate the organization of the agencies necessary to bridge the period of transition from peace to war and lead to early victory."

The plan then specifies (*a*) the coordinating measures which may be applied to establish priority in the procurement program, control of prices, control of trade with foreign countries, and the organization of government corporations to render service or take business risks unreasonable for privately owned bodies; and (*b*) the organizational set-up necessary to assist the President acting under his wartime powers.

BOTH MILITARY AND INDUSTRIAL MOBILIZATION MUST BE CONSIDERED

City planning must concern itself with military mobilization, just as it does with the population of municipal units and with migration. Military units must be assembled for processing and training. Communities will have a decided interest in where these units are to be located and their size. Usually they will be competent to collaborate in their location. If these units are to be relatively small—say, companies and battalions—and located within the limits of the community, it would mean one thing to the communities' utilities, streets, and transportation facilities. If they are to be large—perhaps larger than the population of the community itself—and located nearby in the open country, another set of problems would be raised and have to be met, with still broader planning implications.

City planning is very closely related to industrial mobilization. The coordination of industrial activity as conceived in the preparedness program will be well knit on a national basis. There will be extensions of existing industrial plants and the construction of some new ones. There will be a wide range in the nature and size of industrial facilities. The location of such facilities will be important to the community, and how they are to be reached by a transportation system integrated with the city structure. Much can be done in advance planning to overcome the many hardships and haphazard conditions which prevailed in many cities during the World War. It is perhaps in decentralization of industrial mobilization that city planning can make its greatest contribution, not only in helping to make the industrial program work smoothly and efficiently, but in preparing at the same time for a post-war period almost as difficult as the wartime years.

City planning will be concerned with the public spirit, which represents our attitudes toward life—the will to

accomplish, and a sense of the dignity of human life. Matters affecting general morale will be facilities for recreation and community life, housing conditions, schools, hospitals, and public health, and transportation facilities.

A brief review of some of the conditions that prevailed in our cities during the last war may point out the need

DÜSSELDORF, A WELL-PLANNED HARBOR ON THE RHINE

for local community planning measures contributory to the present preparedness program. We remember:

1. Great concentrations of office workers at several points in the community, in both public and private buildings, and still greater concentrations of munitions workers in industrial plants.
2. Great congestion of traffic on the major streets, where these buildings were located, and on connecting thoroughfares.
3. Great congestion in storage space and railroad trackage, particularly in important railroad junctions and ports.
4. Greatly increased demand for housing facilities, and increased rentals in many cases.
5. Much shifting of workers in offices and plants from one type of work to another, and from one community to another.
6. Use of public open spaces for emergency construction.
7. Greatly increased load upon public utilities of all types.

A strong test of city planning will be made during the next war, along these lines, despite efforts to spread the war effort over a greater geographical area in the industrial field.

COORDINATION WITH INDUSTRIAL MOBILIZATION PLAN

Local community planning measures must be articulated with the centralized control of the preparedness program. The industrial mobilization plan has examined the conditions, as they relate to industrial operations, and has endeavored to prevent unfortunate developments by decentralization and controlled distribution of the war load through the medium of procurement planning districts and maintenance of balance between the demands upon the districts.

Procurement planning for needed military supplies has devised methods which are flexible and responsive to conditions, but far-reaching and comprehensive. The essence of the method is to call for the various types of supplies from the parts of the country that can best supply them. "Best" means taking into consideration the skills of the people, the existing equipment of plants, the geographical and strategic position of the district, transportation requirements and facilities, and other contributory elements. A district might be capable of doing much more in some specific line than is assigned to it, but should it do so, much needed production in other lines might be interfered with and an unbalanced condition might prevail, as regards optimum results in production, the meeting of civilian needs, and the migration of workers. This method of planning, only suggested in brief, has been in application now for a number of years by the Army and Navy, and should make the transition from peacetime and neutrality to an emergency a relatively smooth one. A high degree of cooperation with industrialists and manufacturers has been arrived at in the planning so far, through the medium of the procurement planning officers assigned to the various districts. In principle, at least, there should be little in the way of major uncertainties in the industrial field.

Let us now consider some of the local planning measures that should be considered as contributory to the preparedness program. These are listed in no particular order of priority, for community problems vary in scale, scope, and variety throughout the country.

TRAFFIC AND TRANSPORTATION:

- Definite solution of the problem of motor-vehicle parking space in central congested areas.
- Expansion of provisions for off-the-street loading and unloading of business and commercial vehicles.
- Simplification of traffic routes and traffic control.
- Integration of vehicular traffic with rail, water, and air transportation.

INDUSTRY:

- Proper direction in the physical location of new and appropriate industrial plants and control of extensions. (This is not in any sense to be construed as placing of obstacles in an emergency, but, on the contrary, as intelligent development of the facilities so that they will not face undue competition after the war by reason of unfavorable location.) Traffic congestion, flood plain location, and interference with residential uses are the major conflicts to be avoided. This all goes back to the need for a good zoning plan.
- Consideration of the effect of certain types of industries upon the community from the point of view of possible permanency after the emergency (that is, whether they will be an asset or a liability for that particular community).

HOUSING:

- Adequacy of low-rental housing, both quantitatively and qualitatively.
- Possibility of exchange in land uses in favor of housing (related to zoning provisions).
- Air-raid shelters (not yet considered of imminent importance to us).

RECREATION:

- Adequacy of provisions for recreation and community life, taking into account the character of population. (This means a program of activity as well as space and facilities.)

HOSPITALIZATION AND PUBLIC HEALTH:

- Adequacy and balance of hospital plant and staff.
- Decided extension of public health services.

UTILITIES:

- Reexamination of water supply and distribution, waste disposal, and power and light.

AIRPORTS:

- Location of airports in collaboration with Civil Aeronautics Authority.
- Adequacy of development for local and interstate use.

In brief, there is much to be done, and it is the time for all city planners, as well as all those who think in like terms, to consider their responsibilities to their community and to the nation, dispassionately and thoroughly.

Settlement Studies of Huey P. Long Bridge

Pier Movements Over Six-Year Period Compared with Predictions

By WILLIAM P. KIMBALL

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PROFESSOR OF CIVIL ENGINEERING, THAYER SCHOOL OF CIVIL ENGINEERING, HANOVER, N.H.

TO the foundation engineer interested in the value of soil mechanics to his work, says Professor Kimball, the studies of settlement of the Huey P. Long Bridge piers offer a comparison between theory and practice that is nearly ideal. The principles of soil mechanics were utilized in making a settlement analysis of this structure before it was built, and accurate and complete records of actual settlement have been kept ever since. Professor Kimball here compares predictions with observations, offers some interesting comments on "factors of ignorance," and discusses at some length the interesting phenomenon of change in pier elevation with river stage. The article is abridged from a paper before the Soil Mechanics Division at the 1940 Annual Meeting.

A DETAILED description of the soil laboratory tests and settlement analysis carried out prior to the construction of the Huey P. Long Bridge at New Orleans was presented at the International Conference on Soil Mechanics and Foundation Engineering at Harvard University in June 1936 and printed in the *Proceedings* of that conference.[1] Authoritative articles describing the construction of the bridge piers were published both in *Engineering News-Record*[2,3] and in CIVIL ENGINEERING[4,5] during 1933–1936. It is the aim of this paper to supplement the information made available in the above-mentioned papers. Settlement observations have been continued and form the basis for discussions, presented here, which were not possible at the time the previous papers were written. For background purposes the author has drawn from the publications mentioned above, to the writers of which he acknowledges his indebtedness.

Although the idea of a bridge across the Mississippi River near New Orleans was not new, the means of carrying it out were. This was remarked by Carlton S. Proctor, M. Am. Soc. C.E., in his paper "Bridge Foundations" printed in the fifth volume of the Publications of the International Association for Bridge and Structural Engineering:

"The New Orleans bridge would probably have been built years before it was, if it had not been for the question of the feasibility of installing stable foundations. . . . Soil mechanics laboratory analyses and tests demonstrated conclusively that foundations on the upper gumbo stratum would be entirely unsafe and economic studies demonstrated that foundations on the sand stratum at minus 250 would involve costs entirely prohibitive to the construction of the bridge. . . . But these laboratory studies demonstrated the adequacy under proper intensities and proper design treatment of the sand stratum at minus 185 and facilitated definite knowledge of the characteristics of this stratum and the pier. . . . Thorough soil mechanics investigations . . . developed . . . the fact that pier settlements would be less and allowable intensities greater at this level, than at the lower levels previously assumed."

The soil studies were begun in 1926, with four borings carried 600 ft below the ground surface and two to −300. Samples were tested by Karl von Terzaghi, M. Am. Soc. C.E., who prepared a preliminary report on the load-bearing characteristics of the clay strata and on the probable settlement of piers founded above them. In the fall of 1931 the plans were completed and the construction contracts let. The foundations contracts required the contractor to make additional borings at the locations of the piers. These were made during the winter and spring of 1933 and provided the undisturbed soil samples which, together with the boring logs, formed the basis for the writer's settlement predictions which were completed in June 1933. Construction of the piers was begun in 1933 and the bridge was opened on December 16, 1935.

The portion of the structure with which we are concerned here is shown in Fig. 1. Piers 1 to 5 are located within the permanent river bed, and Pier A is beyond the west levee. All these piers are of reinforced concrete, and were sunk by open dredging methods, the caissons for four of them (Piers 1 to 4) being put down through sand islands.

To the student of applied soil mechanics and to the foundation engineer interested in the value of soil mechanics in his work, this project offers a comparison between theory and practice which is nearly ideal. Preliminary subsurface explorations were scientifically and carefully performed. Laboratory tests were made on a large number of undisturbed samples. The principles of soil mechanics were utilized in making a settlement analysis of the structure before records of performance were available to influence the theoretical analysis. The Public Belt Railroad Commission through its consulting engineers, Modjeski and Masters, has kept accurate and complete records of pier settlements continuously since construction was begun and, to its great

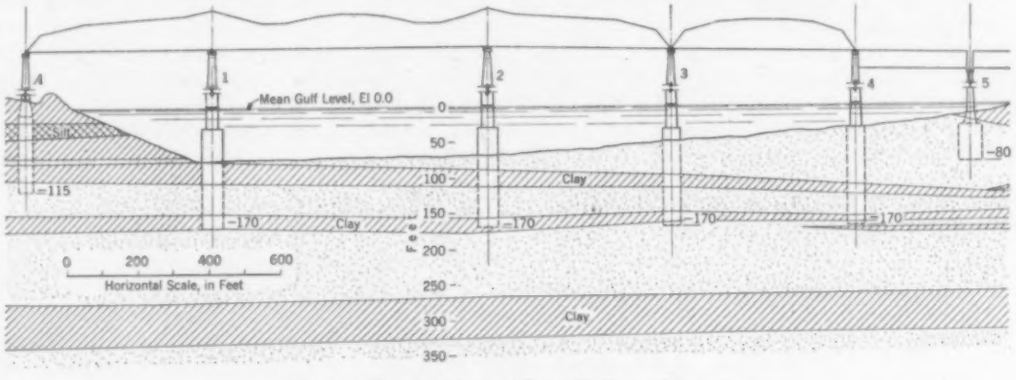

FIG. 1. SOIL PROFILE, HUEY P. LONG BRIDGE

credit, has made these records available to the profession. And finally, the observations have disclosed a phenomenon of pier movement during the flood stages of the river unprecedented in the completeness and accuracy of its determination.

In Fig. 2 are shown actual settlement records of Pier 1 correlated with the river stage from the landing of the caisson to 1939. The general trend of progressive settlement, though apparent, is obscured by the fluctuation of the piers with changes in the river stage. These flood effects will be discussed later. For the purpose of comparing the settlement predictions with the observations, Fig. 3 has been prepared by plotting separately the observations at low water and at high stages. Since the settlement predictions were based on a river stage of zero, they should coincide with the low-water readings. A study of Fig. 3 suggests certain conclusions with regard to the accuracy of the settlement predictions:

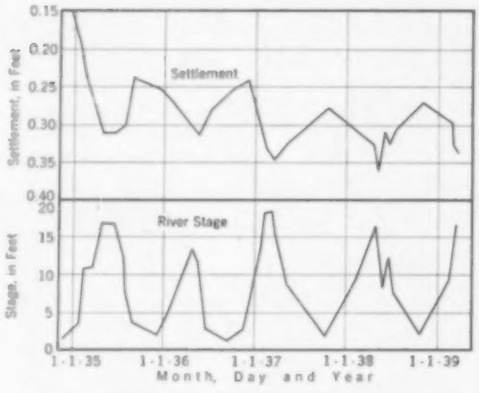

FIG. 2. SETTLEMENT OF PIER 1, CORRELATED WITH RIVER STAGE

1. The order of magnitude of the pier settlements was accurately predicted.
2. The bulk of the settlement, approximately 70%, was correctly predicted to occur during the construction period.
3. The magnitude and rate of progressive settlement following the completion of the structure were predicted with reasonable accuracy.
4. The settlement of Piers 1 and 2 during the construction period was predicted with reasonable accuracy.
5. The settlement of Piers 3, 4, and 5 during the construction period was underestimated by nearly 50%.
6. It was predicted that Piers 3 and 4 would settle during construction considerably less than Piers 1 and 2 and about the same as Pier 5. Actually Piers 3 and 4 settled about the same as Piers 1 and 2 and considerably more than Pier 5.

The agreement between the predictions and the observations noted in the first four of these conclusions can be ascribed either to sound methods of settlement analysis or to singular coincidences. The disagreement noted in the last two conclusions can similarly be ascribed either to discrepancies in the methods of settlement analysis used or to singular coincidences. In view of the results obtained it should be interesting to review the methods used.

BORING AND SAMPLING PROCEDURES

Boring and sampling procedures used in the 1933 investigations are illustrated in Fig. 4 (*a*). The 8-in. pipe sunk to the bottom of the river served as protection for the 4-in. casing sunk to the full depth of the boring. In order to prevent "freezing," special "drilling mud" was recirculated in advancing the casing by the regular wash-boring method. Samples were obtained below the foot of the casing at not more than 5-ft intervals, or wherever a change in the nature of the soil was observed. The essential features of the sampling spoon are shown in Fig. 4 (*b*). The split barrel was held together at top and bottom by 3-in. lengths of Shelby steel tube, the bottom length being shaped to form a beveled cutting edge. An ordinary ball valve, protected from clogging by a drilled plug, allowed water to pass upward while the spoon was lowered and prevented the weight of the water from acting on the top of the sample during extraction. A split lining tube was used, samples being cut from the most nearly undisturbed section of the complete sample and shipped to the laboratory in paraffin and glass jars.

The possible disturbance of a sample and mechanical difficulties involved in transferring it from its original container to a testing ring in the laboratory have given rise to the suggestion that undisturbed tests be made in the original container. Many of the samples obtained at this site consisted of clay with varves of silt. By the time these samples reached the laboratory the capillary action of the clay had withdrawn the water from the silt varves, leaving them light-colored in comparison with the saturated clay and disclosing a clear picture of the distortion of the soil by the inside surface of the spoon. The distortion, which extended about one-eighth of an inch in from the periphery of the sample, clearly requires the outer portion of the sample to be discarded for undisturbed testing.

POSSIBLE SOURCE OF INACCURACIES

No matter how reliable borings and soil samples may be, undue weight can be attached to isolated borings, and the inaccuracies of the 1933 settlement estimate may have been caused in part by this. The soil profile under each pier was developed from the records of the two borings made at the site of that pier without regard to the profile at adjacent piers or to the general soil profile (Fig. 1), which showed the deposit across the river to be generally very uniform within the permanent river bed. Even in so uniform a deposit, minor inconsistencies should be expected, and it is believed that the variations indicated by individual borings reflect these minor and small-area inconsistencies rather than a wide variation which might extend across the entire area of a pier. Interpreting the soil borings in this way, the writer has developed an average soil profile which he believes more accurately represents the soil deposit actually underlying Piers 1 to 5. The "1939 estimate" curves shown in Fig. 3 have been obtained by using this average soil profile rather than the individual profiles used in the 1933 estimate. Although discrepancies in the estimates of Piers 4 and 5 are not eliminated, this estimate is seen to agree more closely with the observed settlements of Piers 1 and 2, and largely to correct the inconsistency noted in the 1933 estimate for Pier 3.

Soil mechanics research in the laboratory and in the field may at some future date shed light on the remaining inconsistencies or on the "singular coincidences" of this settlement analysis. Every settlement analysis is made on the basis of knowledge possessed and in spite of certain factors of ignorance. Those recognizable in this estimate are worthy of mention.

As shown in Fig. 1, the piers of the New Orleans bridge are underlaid by strata of sand and strata of clay. Consolidation of the clay strata accounts for approximately 50% of the observed settlement, the remainder apparently taking place in the sand. In preparing the settlement estimates it was assumed that pier settlement caused by these deep-lying sand strata could be approximated from the results of consolidation tests on the undisturbed sand samples. The estimates have been criticized for this assumption. It is believed that the settlement of structures on sand is caused jointly by

vertical compaction and by lateral yield. The former can be estimated by the widely accepted theory of consolidation, whereas no reliable method of forecasting the settlement caused by lateral yield has yet been developed. There is little if any experimental evidence as to the relative magnitude of the two factors. The settlement of a loaded plate on the surface of a bed of sand is believed to be caused almost entirely by lateral yield, the vertical compaction being a relatively negligible factor. The writer submits, however, that the settlement of a loaded plate buried to a great depth is caused almost entirely by vertical compaction, the lateral yield, owing to confinement of the overlying material, being a relatively negligible factor. The piers of the New Orleans bridge are believed to lie somewhere between these two extremes. This hypothesis is subject to experimental verification, which might help to eliminate one of the factors of ignorance.

TABLE I. EFFECT OF RIVER STAGES ON PIER ELEVATIONS

Dates		Change in River Stage, Ft	Pier 1		Pier 2		Pier 3		Pier 4		Pier 5	
From	To		a*	b†	a*	b†	a*	b†	a*	b†	a*	b†
12-10-35	1-21-36	+ 2.6	14	5.8	− 1	− 0.4	14	5.8	22	8.5	16	6.3
1-21-36	4-24-36	+ 8.8	40	4.6	47	5.4	63	7.2	66	7.5	54	6.1
4-24-36	5-12-36	− 1.6	− 4	− 2.5	−10	− 6.3	−15	− 9.4	− 7	−4.4	− 3	− 1.9
5-12-36	6-18-36	− 9.0	28	3.1	42	4.7	36	4.0	56	6.2	36	4.0
6-18-36	9-16-36	− 1.5	29	19.4	16	10.7	22	14.7	5	3.3	18	12.0
9-16-36	11-24-36	+ 3.0	−16	− 5.3	− 4	− 1.3	9	3.0	14	4.7	16	5.4
11-24-36	1-27-37	+10.8	84	7.8	72	6.7	62	5.8	48	4.5	46	4.3
1-27-37	2- 2-37	+ 1.6	1	0.6	11	6.9	16	10.0	14	8.7	11	6.9
2- 2-37	2-12-37	+ 2.9	8	2.8	12	4.1	− 7	− 2.4	− 3	−1.0	3	1.0
2-12-37	3- 5-37	+ 0.3	−10	−33.3	−14	−46.7	1	3.3	1	3.3	− 8	−26.7
3- 5-37	3-11-37	− 0.8	− 5	− 6.3	− 6	− 7.5	2	2.5	4	5.0	− 2	− 2.5
3-11-37	3-22-37	− 2.4	8	3.3	10	4.2	3	1.2	8	3.3	14	5.8
3-22-37	5- 3-37	− 6.9	14	2.1	10	1.5	−10	− 1.5	0	0.0	12	1.8
5- 3-37	10-11-37	− 6.9	49	7.2	44	6.5	44	6.5	31	4.6	40	5.9
10-11-37	2-15-38	+ 7.7	34	4.4	32	4.2	5	0.7	35	4.6	36	4.7
2-15-38	4-12-38	+ 5.3	18	3.4	7	1.3	19	3.6	20	3.8	20	3.8
4-12-38	4-30-38	+ 1.7	34	20.0	40	23.5	24	14.2	4	2.4	8	4.7
4-30-38	5-15-38	− 4.7	35	7.5	27	5.7	36	7.7	31	6.6	28	6.0
5-15-38	5-25-38	− 3.8	18	4.7	14	3.7	2	0.5	13	3.7	− 2	− 0.5
5-25-38	6-16-38	+ 4.4	18	4.1	12	2.7	15	3.4	21	4.8	− 1	− 0.2
6-16-38	6-24-38	− 1.0	7	7.0	−12	−12.0	− 7	− 7.0	− 6	−6.0	0	0.0
6-24-38	7- 7-38	− 3.9	12	3.1	25	6.4	22	5.6	17	4.3	17	4.3
7- 7-38	10-19-38	− 5.3	34	6.4	54	10.2	46	8.7	50	9.4	30	5.7
10-19-38	2-13-39	+ 7.2	26	3.6	44	6.1	39	5.4	44	6.1	38	5.3
2-13-39	2-20-39	+ 3.4	28	8.2	24	7.1	20	5.9	17	5.0	16	4.7
2-20-39	3-13-39	+ 3.6	14	3.9	22	6.1	22	6.1	11	3.1	14	3.9

* a = Rise of pier corresponding to drop of water, or drop of pier corresponding to rise of water—thousandths of a foot.

† b = Change of pier elevation per foot change in river stage—thousandths of a foot.

OTHER SOURCES OF UNCERTAINTY

Another important source of uncertainty, particularly in cases of deep piers subject to only small settlements, is the condition of the bearing stratum on which the structure rests. Undoubtedly a considerable early settlement may be due to the surface adjustment of soil which has been disturbed during the preparation of the bottom. Unfortunately the amount of such settlement will always be unpredictable.

It has been further assumed that all the load is transmitted to the soil at the bottom of the caisson seal. The load that might be permanently transmitted through skin friction along the sides of the pier has never been determined.

In spite of extensive research on the distribution of stress through soil, experimental verification of current stress theories is meager and conflicting; there is no widespread agreement on methods of calculating stress; and the theories that have been advanced lead to widely varying results. In the settlement analysis of these piers made in 1933, stresses were computed on the basis of Boussinesq's classic equation. The determination of stresses at various locations and depths and the weighting of these to determine the average stress at ruling elevations under each pier, was a laborious process requiring approximately 100 man-hours. The average stresses at the same elevations under each pier were recomputed in the preparation of this paper in less than two hours on the assumption that the load on the pier base is spread through the underlying soil between planes making an angle of 60° with the horizontal. This method of computing stresses is specified in the recently prepared Boston Code Chapter on Foundations for the purpose of comparing stresses with allowable bearing values of underlying soil strata. Applying the stresses computed by this simplified method to this particular settlement

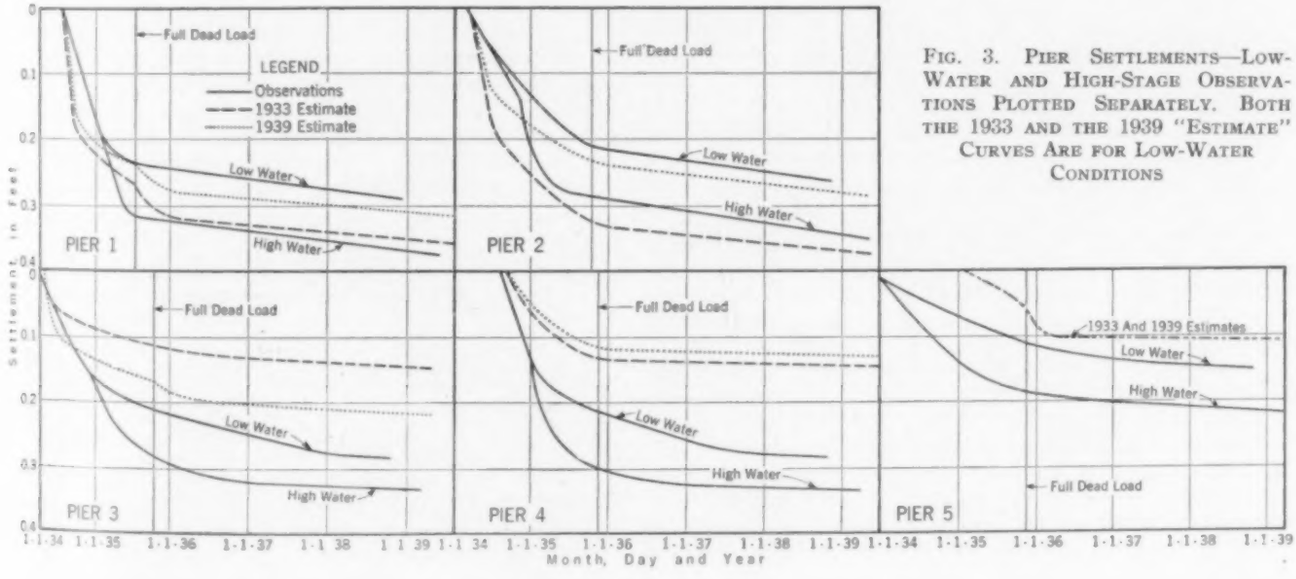

FIG. 3. PIER SETTLEMENTS—LOW-WATER AND HIGH-STAGE OBSERVATIONS PLOTTED SEPARATELY. BOTH THE 1933 AND THE 1939 "ESTIMATE" CURVES ARE FOR LOW-WATER CONDITIONS

analysis results in differences in the estimated ultimate settlements of less than 5%. Not only is this a practically negligible difference, but there is no indication at the present time that the stresses so computed are less accurate than those resulting from the tedious application of more complex stress theories. Until such time as convincing experimental verification may indicate that the stresses computed by this method are substantially incorrect the writer will prefer its use.

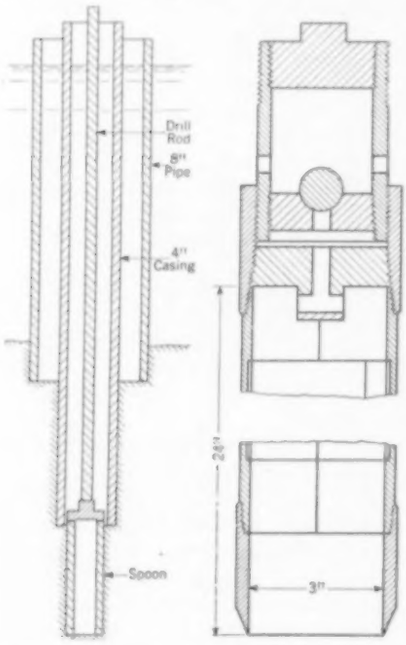

FIG. 4. BORING AND SAMPLING EQUIPMENT
(*a*) General Installation, (*b*) Detail of Sampling Spoon

The effect of the river stage on the elevation of Pier 1 throughout the five-year period from 1935 to 1939 has been shown graphically in Fig. 2. The variations in elevation of Piers 2 to 5 have been similar, as shown in Table I. Of the 26 changes in elevation observed since the completion of the bridge, it will be noted that about 6 in each pier represent departures from the general trend. The relations shown in Table II are found by averaging the remaining 20 changes. These averages indicate that, with infrequent exceptions, a change in the river stage of 1 ft is accompanied by a corresponding change in elevation of the bridge piers of 0.005 ft, regardless of the weight of the pier or of the landing elevation.

TABLE II. GENERAL RIVER STAGE–PIER ELEVATION RELATIONSHIPS

PIER	NET UNIT LOAD, TONS PER SQ FT	ELEVATION OF PIER BASE	AVERAGE CHANGE IN PIER EL. PER FT CHANGE IN RIVER STAGE
I	3.35	−170	0.0049 ft
II	3.10	−170	0.0055 ft
III	2.50	−170	0.0053 ft
IV	1.65	−170	0.0054 ft
V	0.55	− 80	0.0051 ft

Further study of Table I shows that the ratio between change in river stage and change in pier elevation has remained substantially constant throughout the five-year period, indicating that the action is purely elastic. All the indications point to the conclusion that a rise in the river stage imposes a load on the soil deposit underlying the piers, compressing it elastically, the rebound on removal of the load being complete.

NEW ORLEANS PIERS LOWER AS RIVER RISES

Settlement records have indicated that many structures change elevation with changes in the level of the surrounding ground-water table, the reduction of the effective weight by the increased hydrostatic uplift accompanying a rise in the water level resulting in a rise of the structure followed by a corresponding settlement as the water level drops. The piers of the New Orleans bridge, however, undergo the opposite action. Careful check levels having proved that the observed pier movements could not be attributed to disturbance of the reference bench marks, the peculiar action of the piers was brought to the attention of the International Conference on Soil Mechanics and Foundation Engineering held at Harvard University in 1936. Discussion was unfortunately closed by the explanation that the flood waters acted as a load on the underlying strata, hydrostatic uplift being prevented by the continuous clay blanket underlying the river bed, which was said to prevent "free communication between the river and the ground water located below"[1] it. While this "clay blanket" theory appears to be perfectly logical, it seems at variance with other observations.

"CLAY BLANKET" THEORY QUESTIONABLE

In *Engineering News-Record* for June 18, 1936, Dr. Terzaghi[6] described laboratory tests for determining the transmission of hydrostatic uplift through clay and concrete which led to the following conclusion: "For concrete and for plastic clay the reduction factor x was found to be practically equal to unity which indicates that the hydrostatic uplift in these materials is almost as active as it is in a sand." In view of this experimental evidence it would appear that the clay blanket across the bed of the river is "almost as active" in permitting a "free communication between the river and the ground water located below" the blanket as if this clay were sand. If this is true, the clay blanket theory must be discarded.

A similar movement relative to water level has been noted in the Pennsylvania Railroad tunnel under the Hudson River at New York City. In the 1910 TRANSACTIONS of the American Society of Civil Engineers[7] it is remarked as an "interesting phenomenon" that the tunnel undergoes an average settlement of 0.008 ft coincident with an average rise of the tide of 4.38 ft, with an equal rise of the tunnel as the tide falls. There is no clay blanket overlying this tunnel. Instead, there is a silt which is described as being so soft that it acts practically as a fluid. Yet the parallel between the action of the tunnel and the action of the bridge piers is exact. As in the case of the bridge piers, the amount of rise and fall is independent of the weight of the structure, the same amount having been observed both before and after the placing of the concrete tunnel lining, and the action continued undiminished for the twenty years during which the records were kept. In the absence of clay, the action of this tunnel cannot be explained by the clay blanket theory.

The action of the New Orleans piers gives no concern to the engineers connected with the project and may not even be important from an engineering point of view. As a phenomenon for which there has been no sound explanation offered, however, the writer feels that it should stimulate the interest of engineers having a sincere intellectual curiosity with regard to soil mechanics.

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Wind Pressure on Structures

A Survey of Recent Developments in Aerodynamics

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IN this article Mr. Howe presents ideas and data from recent experiments on wind effects—particularly on open structural frames. His discussion of the theoretical concepts is brief and enlightening, and he follows it with an excellent summary of practical data for use in design. For those with special problems there is a well-chosen bibliography of source material at the end of the article.

EXCEPT in a few recent cases, structural engineers have based their designs to resist wind forces on intensities obtained by weighing the resistance of small, thin, flat plates or pressure boards exposed to air flow or to motion against still air.

Of late more thorough investigations in aerodynamics and fluid mechanics have shown the error of this pure assumption. Usually pressures on such dissimilar objects as flat plates and three-dimensional objects are quite different. Also, total wind effect on all flat plates and other objects has been shown to be due to two factors—positive (+) pressure on the windward side and negative (−) pressure on the leeward side.

It is apparent that any horizontal force assumed for the design will be resisted by the structure. When the assumed force is of wrong magnitude, the error results either in a reduced factor of safety or a waste of material. The error in not providing for suction effect has resulted in damage to structures when roofs were lifted off or when walls failed outward. Of unusual interest in this regard is a report by the Associated Factory Mutual Fire Insurance Companies on the New England hurricane of September 1938.[1]

The following exposition will present ideas and data obtained from present-day experiments and will relate largely to wind effect on open structural frames. Maximum wind velocities and wind pressure on buildings have already been discussed by a subcommittee of the Structural Division of the American Society of Civil Engineers.[2a,2b]

A FEW FUNDAMENTAL IDEAS

Wind is fluid motion. In order to understand this, the idea that wind effect is the result of resistance to fluid motion must be substituted for the older idea that it is the result of the impingement of an infinite number of small particles on an exposed surface.

The case of an object subjected to wind pressure is that of a body deeply immersed in a fluid at a static pressure of about 2,100 lb per sq ft. The effect of motion in a severe storm is to vary this pressure some ±2 or 3%.

The general formula for fluid pressure is:

$$P = c\,q\,A\,f(\mathbf{R}),$$

in which P = the total force of the resistance to fluid motion

c = a coefficient

q = dynamic, velocity, or stagnation pressure $= \frac{mV^2}{2}$

A = the area of the surface or the projected area of the member, as the case may require

$f(\mathbf{R})$ = function of **R**, Reynolds number

Therefore P varies: (1) as the velocity pressure, (2) as some function of **R**, and (3) as the value of a coefficient c, which depends on the shape of the object.

The value V is not always understood. The flow pattern of a natural wind is usually complex. In order to obtain values for P under conditions that can be analyzed and understood, it is necessary to perform experiments under simple, standard conditions. For this reason wind-pressure coefficients are based on a value V, the velocity of a uniform approaching wind, the stream lines of which are straight and parallel with the general direction of flow. Consistent results cannot be obtained if the point for measuring velocity is selected at random.

In pounds per square foot, q has the value of $0.00256V^2$, V being in miles per hour. As our present knowledge is insufficient to express them by formulas, c and $f(\mathbf{R})$ are obtained by experiment. Many objects dealt with in structural engineering have flat surfaces and sharp edges. Experiments show that with such objects "scale effect" is negligible, and $f(\mathbf{R})$ may be disregarded. The formula for p (unit pressure) therefore becomes for most cases simply $p = cq$, which has the advantage that c is nondimensional. The method of noting pressures by c coefficients has now been adopted by most international associations in the field of aerodynamics.

The value of c depends on the shape of the object and varies with the location on the object of any particular pressure point. Positive values of c will be found on windward faces only and will not exceed 1.0. At nearly all points on windward surfaces the pressure will be affected by components of lateral flow. The average will be less than stagnation pressure, and c will be less than 1.0. Negative values of c will be found on roofs, ends, and leeward faces, and may be as high as −2.0 or even more. The c values for windward faces of buildings depend on the ratio of height to width. The c values for leeward faces depend, in addition, on the ratio of height to depth, depth in this case being the distance between front and rear faces. These facts account in part for the many coefficients that have been reported by various experimenters. The impact pressure theory of Newton did not account for such widely differing values.

WIND EFFECT ON INDIVIDUAL SHAPES

We now consider c values for various separate shapes or members of a variety of cross sections. Usually such members are quite long in proportion to their width. The effect of wind flow around their ends is negligible and the length-to-width ratio may be considered to be infinitely large. For such members the German scientist, Dr. Ing. O. Flachsbart,[3a] has given the c- values shown in Fig. 1, based on experiments at Göttingen, as reported by Prandtl and Betz.[4,5] These values for c, when used in the formula $P = cqA$, give the total wind force acting on the member. A is the projected area, and in the case of the two-channel member, A includes the space between the channels. Dr. Flachsbart points out that for these shapes an average value for c is approximately 2.0.

When such shapes are used together in a framework the error is small if $c = 2.0$ is used for all the members.

Values of c for wind effect on the projected areas of round bars or wires vary as $f(\mathbf{R})$. A diagram for such cases is given by W. Watters Pagon in his article, "What Aerodynamics Can Teach the Civil Engineer."[6] Noting that $\mathbf{R}$ is equal to 9,400 VD, we have, when V equals 75 miles per hour and D is 0.14 ft, $\mathbf{R} = 100{,}000$. Referring to Fig. 1, we have at this number a value of $c = 1.2$, which remains constant for lower numbers down to 20,000 but decreases rapidly soon after passing 200,000.

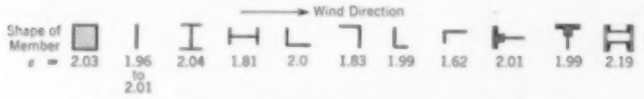

FIG. 1. VALUES OF c FOR VARIOUS SEPARATE SHAPES AND MEMBERS

Engineers have often used assumed pressures for cylinders at 0.50 to 0.60 of pressures for flat plates. For such assumptions $c = 0.65$ to 0.75, which the diagram shows is much too low for small rods of, say, 2 to 4 in. in diameter. At a diameter of 1.0 ft, c becomes smaller than most engineers would care to specify. Information is lacking for values of $\mathbf{R}$ above 1,000,000.

WIND EFFECT ON SOLID-WEB GIRDERS

We next consider wind effect on a single member such as a solid-web girder, for which the flat plate is a similar object of comparison. Eiffel has defined the ratio of the horizontal dimension (length) to the width as the aspect ratio of a flat plate. An aspect ratio of 1 indicates a square plate. The following values of c for total pressures on single flat plates have been deduced from the experiments of Sir Thomas Stanton[7] and Alexander Gustave Eiffel:[8]

Aspect Ratio	1	1.5	2	3	5	6	9	10	14.6
c (Eiffel)	1.28	1.33	1.36	1.37	....	1.41	1.45	1.46	1.60
c (Stanton)	1.25	....	....	1.26	1.28	....	....	1.42	....

Aspect Ratio	15	20	25	30	40.0	41.5	50	60
c (Eiffel)	....	1.71	....	1.79	....	1.84	1.88	....
c (Stanton)	1.48	1.60	1.68	1.75	1.85	....	1.90	1.97

The independent work by both scientists shows that c increases as the aspect ratio increases and approaches a value of 2.0 as the aspect ratio approaches infinity. For square plates the negative pressure is about one-third the total wind effect. For long narrow plates the negative pressure exceeds one-half the total.

From the preceding it would seem that for single solid-web girders of ordinary length a value of $c = 1.45$ would be reasonable. It may be noted, however, that the Göttingen experiments[4,5] showed c values of 1.27 and 1.38 for a single solid-web girder with an aspect ratio (based on the average depth) of 9.5.

WIND EFFECT ON SINGLE LATTICE FRAMES

For single lattice-trusses it has been found by experiment[3b] with a variety of types of web systems that c may be taken to be independent of the outline of the truss and of the type of the web system and shape of the single web member. If the web members are long and slender, c becomes practically the same as for single structural members standing alone. As the members become shorter and wider, and as the joint plates become larger, the percentage of open area becomes less and the c value is smaller. Again, for very long trusses, as the percentage of open space becomes very small, so that the truss as a whole approaches the case of a solid plate of infinite length, c approaches a value of 2.0.

In selecting the value of c for a truss, it is convenient to consider the "solidity ratio," $G = A/A'$, in which A' is the total area included within the limiting boundary lines of the truss, and A is the actual projected area of the members of the truss. (In $p = cq$, the unit pressure p acts on the area A.) For trusses of ordinary single spans Dr. Flachsbart has recommended[3b] the following values:

$c = 1.8$ for values of G less than 0.25
$c = 1.6$ for values of G equal to or more than 0.25

For a series of spans or for long trusses he recommends:

$c = 2.0$ for values of $G = 0.00$ to 0.20
$c = 1.8$ for values of $G = 0.20$ to 0.30
$c = 1.6$ for values of $G = 0.30$ to 0.90
$c = 2.0$ for values of $G = 0.90$ to 1.00

These values might also apply to any sort of framework lying in a single plane, such as a line of building columns with connecting beams and bracing.

SHIELDING EFFECT ON LEEWARD MEMBER

We now consider the case of two members placed one behind the other along the line of the wind's direction. For this case the first member is said to have a shielding effect on the second or leeward member.

When a single object obstructs fluid motion, the pressure of its opposing face divides the flow, causing it to pass around all available sides of the object. Later, the pressure of the outer mass of the fluid unites the flow lines at a point to leeward. There is then an outer curving streamline beyond which the velocity is nearly that of the moving stream. Between that line and the object exists a turbulent region where fluid pressures of the general stream are distorted.

When two objects are so near to each other that their eddy regions overlap, the pressure coefficients for either body are the result of the combined influence of both bodies on the stream flow. When this occurs, the windward or No. 1 body lies within the front pressure region of the rear or No. 2 body, and the No. 2 body lies within the rear eddy region belonging to the No. 1 body.

It is important to note that when the direction of flow is not parallel with the common axis of the members, eddy regions cease to overlap at smaller separations. A large reduction in shielding effect may thus take place when the angle of incidence is small. At the same time the normal pressure on the objects is practically unreduced.

Data presented by Dr. Flachsbart[3c] show that with a wind direction normal to their webs, there is a shielding effect of 50% on the second of two solid-web girders of aspect ratio 9.5 when placed a distance apart equal to 8 times their depth. At a distance of 5 times the depth there was complete shielding effect. This is not true, however, if the direction of the wind varies from the horizontal.

An interesting case of shielding effect is presented when two plates are near each other, not more than 1.5 to 2.0 diameters apart. Experiments show[7,8] that for such cases the effect of the rear eddy region of the No. 1 plate is to produce a decided force tending to move the rear plate nearer the front one in a direction opposite to that of the stream flow.

For lattice girders, experiments show that the shielding effect varies as the distance between them, e, and as their solidity ratio G. Let:

cq = the unit pressure in lb per sq ft on the projected area A of one truss standing alone

n = a value for the part pressure on the leeward truss to be added to that on the windward truss allowing for shielding effect

$c'q$ = the unit pressure to be taken on the projected area of one truss for the total wind effect on both

Then $c'q = c(1 + n)q$.

Values of n for varying solidity ratios G, for values of $e/h = 1.0, 2.0, 4.0$, and 6.0, are given by Dr. Flachsbart[2c] as shown in Fig. 2, in which e is the distance between trusses, and h the height of truss. These are his recommendations for the coefficients to be used in design for total wind effect on two parallel girders or trusses. The wind direction is assumed to be normal to the web. When $G = 1.0$, a truss becomes a solid-web girder.

From Fig. 2 it will be seen that for small values of G there are larger values for n than common practice in this country is accustomed to require. For light trusses with web members of small diameter, and for the sides of water towers whose diagonal bracing consists of small rods, the G value is not over 0.10 to 0.15. For such cases it would seem reasonable that but little or no shielding

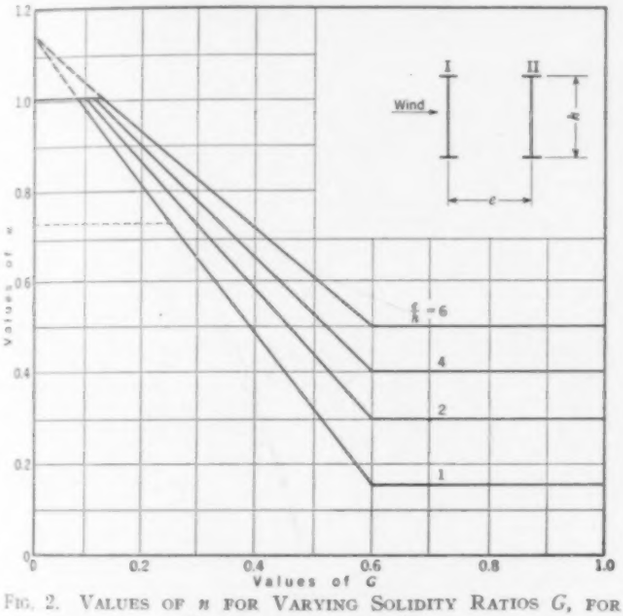

FIG. 2. VALUES OF n FOR VARYING SOLIDITY RATIOS G, FOR VARIOUS VALUES OF e/h

effect be assumed. When the wind direction varies from that of normal to the girder web, values of n will increase.

H. L. Dryden, in his chapter, Wind Pressure on Structures,[9] in the Eshbach *Handbook on Engineering Fundamentals*, refers to experiments made on a model with trusses separated by a space 2.75 times the height of the trusses. In this case the wind direction was varied in both horizontal and vertical directions. "Variation in the vertical plane is most important, the shielding effect disappearing at an angle of 15°." Further experiments on a model consisting of two trusses spaced a distance apart equal to the height of the truss also included a floor between them. "In this case the shape factor referred to the area of one truss reached the value 1.85, and at varying angles in the vertical plane a large lifting force was found."

Dr. Flachsbart has given data[2d] on tests made on a model of a bridge with trusses spaced 1.44 times their height apart, with a floor between at the bottom chord level. The solidity ratio G for the trusses was large, being 0.458. The direction of the wind was varied in a vertical direction. The shape factor c for the total normal component of the wind effect on both trusses was 1.63. When the wind direction was inclined downward at an angle of 20°, c reached a maximum of 1.86, and at this angle the pressure was divided nearly equally between the two trusses. As the angle of inclination increased downward from the horizontal, c for the windward truss decreased. For the lee truss it increased to a maximum of 1.15 when the angle was 35°.

WIND STRUCTURE

The value to be assumed in the design for V, in the formula $q = \frac{\rho V^2}{2g}$, has been given considerable attention. As one basis for this value we have official Weather Bureau records of maximum average wind velocities for 5-minute periods. These records have been discussed by the Committee on Wind Bracing of the Society's Structural Division.[2a] Each record is of the velocity of a single streamline of wind as it passed the instrument location. Anemometers are often located on the roofs of buildings where the flow pattern would be quite different from that of a uniform approaching wind. Then too, gust velocities or those for less than 5-minute periods must be considered.

Detailed observations of wind structure have been made by R. H. Sherlock and M. B. Stout[10] in open country near Ann Arbor, Mich. The instruments used were unusual in that they were especially designed for sensitiveness and accuracy in recording sudden changes in velocity due to gusts. Velocities recorded simultaneously covered a width of 660 ft at a height 50 ft above the ground. The published data show that rapid changes in velocity took place along wave fronts that were curved. One nearly steady wind was observed that lasted several seconds at an average speed of 45 mph on a front 300 ft wide.

A paper by Sir Thomas Stanton[11] discusses wind velocities observed over a width of 350 ft on an apparatus consisting of a row of Dines anemometers placed at the tops of towers 60 ft high. His experiments also included observations at a series of stations located on the footway trusses of the Tower Bridge over the Thames, London, England. These trusses have a span of 225 ft and are located at a height of 141 ft above water level. His general conclusions from these experiments were:

"That in winds of moderate intensity, up to 50 mph, the pressure on a large area during the passage of a gust is, in the majority of cases, appreciably less than that on a small area. There is, however, very definite evidence of the existence of gusts up to 50 mph in which the variation of velocity over the front is so small that, in the case of a structure in an exposed position and having a span of less than 250 ft, the pressure over the whole area is sensibly equal to that at a point in it . . . .

"As regards the effect of gusts of higher intensity than those hitherto measured . . . the general experience of the Tower Bridge experiments tends to confirm the impression that lateral uniformity in speed is more characteristic of high winds than of moderate winds."

A paper recently published by Bailey and Vincent[12] has as its object "a continuation of the work of Sir Thomas Stanton." This paper contains data obtained from wind velocity observations made over a selected length of 2,680 ft on the 4,000-ft bridge over the River Severn, near Sharpness, Gloucestershire, England. For observation purposes, the 2,680-ft section was divided into two equal sections of 1,340 ft each.

The paper states: "So far as this site is concerned, the wind front is generally composed of a series of eddies

of smaller magnitude than 250 ft, which are more or less independent of each other. The likelihood of the average pressure over a wide front being equal to maximum pressure at any one point depends upon the probability of a number of eddies striking simultaneously . . . . It appears, therefore, that the general conclusion drawn by Sir Thomas Stanton from the Tower Bridge experiments is also applicable to structures of much larger dimensions."

Observational data seem to indicate that if a structure is located in the open, where the wind has an unobstructed approach, winds of high velocity may be practically uniform over a wide front. Sudden maximum gust velocities may be expected to cover less width.

CONCLUDING REMARKS

Lack of confidence in the reliability of model tests as furnishing data applicable to large full-sized structures is sometimes met.[13] As far as size of models is concerned, there would seem to be but little choice between those on which either the old formulas or the new ones are based.

It is difficult to obtain wind-pressure data on full-sized structures in natural winds. One has to be on the alert for years in order to be ready to take readings when a wind of high velocity finally occurs. There is also the difficulty of observing the true velocity and structure of the corresponding wind in order to coordinate it with the pressure readings. Data from such observations have not furnished much clear evidence as to just what the wind effect was for a given velocity.

Another consideration is the record of bridges that have remained standing after years of service. Records show but few failures due to wind.

In earlier days the specifications of Theodore Cooper probably were used more than any other in the design of bridges. Cooper's conclusions as to wind pressure on bridges were expressed in the discussion of a paper[14] by C. A. P. Turner, "Probable Wind Pressure Involved in the Wreck of a Mississippi River Bridge," as follows:

For all spans up to about 500 ft, use a lateral force per linear foot of span based on 30-lb per sq ft pressure, plus one-third to provide proper lateral stiffness for "modern train loads and speeds." For all spans exceeding 500 ft, he would suggest: (1) a wind force of 50 lb per sq ft applied to any part of the bridge 60 ft wide at any angle within 30° above or below the horizontal; (2) a wind force of 30 lb over a width of 600 ft; (3) a wind force of 15 lb over a width of 2,000 ft.

Requirements for wind load to be used in design, according to the American Railway Engineering Association specifications (1938 edition), are, for spans not exceeding 400 ft in length: On the bridge (loaded), 30 lb per sq ft on the following surfaces: (*a*) for girder spans, 1½ times the vertical projection of the span; (*b*) for truss spans, the vertical projection of the span plus any portion of the leeward trusses not shielded by the floor system; (*c*) for viaduct towers and bents, the vertical projections of the columns and tower bracing. The wind force "shall not be taken at less than 200 lb a linear foot for the loaded chord or flange, and 150 lb a linear foot for the unloaded chord or flange." For the unloaded bridge a wind pressure of 50 lb instead of 30 lb per sq ft shall be used.

A unit pressure of 30 lb per sq ft is in common use in this country for wind effect on structural frames. Referring to the design formulas recommended by Dr. Flachsbart, assuming a solidity ratio of 0.25 and an e/h ratio of 1, we have for total wind effect on two trusses:

$$p = 1.60(1 + 0.73)q = 2.77q = 0.0071V^2$$

If to $p = 30$ lb per sq ft we add 50% for wind effect on the second truss, we have $p = 45$ lb per sq ft, for which $V = 80$ mph.

For the total wind effect on one truss alone, $p = 1.60q = 0.0041V^2$, and if $p = 30$, $V = 86$ mph.

For those who wish to use the formula $p = kV^2$, present-day experiments show that 0.0033 is not always a correct value to use for k. It should be from 0.0041 to 0.0051, varying according to the proportion of the members. For plate girders the value for k might in some cases be as low as 0.0033. For plate-girder bridges the shielding effect may be practically 100%, but for a light framework there is almost no shielding effect.

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Model Study of Green Mountain Dam Spillway

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The Downstream End of the Model, with a Simulated Discharge of 7,500 Cu Ft per Sec

Green Mountain Dam, now under construction, is a unit of the Colorado–Big Thompson Project, Colo. Design of its spillway presented a number of interesting hydraulic problems that were solved largely by the model study reported here. Among those discussed in particular detail by Mr. Douma are the minimum permissible curvature of the inlet transition, the discharge characteristics of the crest, the design of the chute, and the feasibility of a stilling basin to prevent scour below the dam.

In the hydraulic design of the Green Mountain Dam spillway, model research supplied the basis for a number of important decisions. Particular studies were made of the inlet transition, the spillway crest and gate structure, the high-velocity chute, and the erosion of the river bed downstream. Primary objectives in the model studies were: (1) to establish the minimum radius of curvature of the inlet transition for satisfactory hydraulic performance, (2) to determine the efficiency of the spillway crest and bridge piers, (3) to obtain the most economical and effective hydraulic design of the spillway chute, and (4) to determine the extent of downstream erosion and the feasibility of employing some type of stilling basin to prevent scour.

A plan and elevation of the final design of the concrete spillway are shown in Fig. 1. The inlet transition is curved in plan, with a minimum center-line radius of 200 ft. The crest has a net length of 75 ft, each of the two piers supporting the radial gates being 2 ft 6 in. in width. Below the crest, the spillway chute converges to a width of 30 ft at Sta. 14+22.19. Between that point and Sta. 15+94.13 a smooth transition is provided to the trapezoidal section *C-C*, which extends to the end of the chute. The longitudinal slope, varying from zero at the crest and end of the channel to 50% 130 ft from the end, was determined to fit the mountain-side topography, and provides for a total fall of 228 ft.

The model was constructed to a linear scale of 1 to 40, and required a maximum discharge of 2.47 cu ft per sec to represent the prototype design flood of 25,000 cu ft per sec. Except for the sloping inlet and chute walls, which were of neat cement mortar, it was constructed of smooth pine and redwood, painted with gray enamel as a protective covering. The value of Manning's n for the finished surface was estimated at 0.12.

A problem of considerable economic importance in the spillway design was the size of the inlet channel. Since the material to be excavated is suitable for construction of certain zones of the earth structure, a large inlet is feasible provided rock is not encountered. Should rock be encountered, the smallest-radius inlet hydraulically suitable will be the most economical.

Inlets of 400-ft and 200-ft center-line radius were accordingly studied in the model. Except for some disturbance in the form of surface waves at the inside wall, the smaller inlet proved to be practically as satisfactory hydraulically as the larger. Water-surface profiles at Sta. 9+90, and the crest discharge coefficients, were identical for the two cases. Owing to surface wave disturbance in the 200-ft inlet, it was considered undesirable to further reduce the inlet radius.

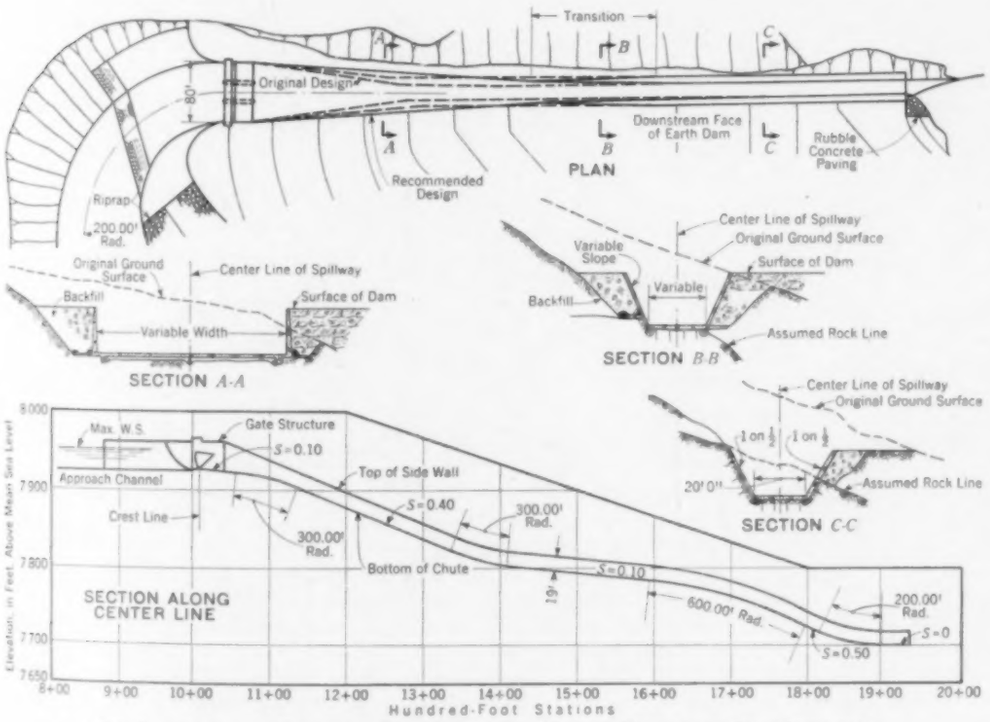

Fig. 1. Plan and Sectional Elevations of Green Mountain Dam Spillway

LOOKING DOWNSTREAM TOWARD THE MODEL CREST, 200-FT RADIUS INLET, WITH MAXIMUM DISCHARGE FLOWING

Observations of the water surface in the chute indicated slightly unsymmetrical but not severe flow conditions, which undoubtedly originated in the curved inlet. A study of the unbalanced flow pattern in the chute led to the conclusion that the energy of flow per unit width entering the chute was greater on the left side than on the right. According to the theory of a curved channel, to have equal energy distribution in a transverse section the bottom must be superelevated. After this was done, however, there was no improvement in chute flow conditions. It is apparent that other factors influence the flow through this type of curved channel. The unsymmetrical change from a trapezoidal to a rectangular section at the crest is probably very significant in the development of the flow pattern.

To check the capacity of the spillway crest, careful discharge measurements were made with the 200-ft radius inlet. The results are shown in Fig. 2. The experimental discharge coefficient C (in $Q = CLH^{3/2}$) for all gates open and 25,000 cu ft per sec flowing is 3.21, which is in excellent agreement with the value of 3.20 used for the original design. For the maximum operating head, the two-gate and one-gate discharges are 58 and 27% of the three-gate discharge, and the corresponding coefficients are 2.76 and 2.62, respectively. For one-gate operation, the center gate has the largest coefficient, the left slightly smaller, and the right smallest. The variation, however, is less than 4%.

The usual procedure in establishing a discharge rating curve for design purposes is to select a discharge coefficient to suit the particular type of crest, and compute several points of the curve using that coefficient for all heads. However, as shown in Fig. 2, the coefficient for any crest shape is by no means constant but decreases with decrease in head. The percentage difference in experimental and design rating curves becomes large for small heads, being 50% for a prototype head of 2 ft in this case. The design rating curve, based on a single constant coefficient, therefore, is not reliable in determining small discharges.

An expression for the variation in discharge coefficient with head, determined to fit the experimental coefficient curve for three-gate operation, was found to be

$$C = \left[10\left(\frac{H}{H'}\right)^{0.007} - 9\right]\left[1 - \frac{0.0007N}{(H/H')^2}\right]C'$$

where H' and C' are the maximum design head and coefficient; H is any head less than maximum and C is the corresponding coefficient; and N is the number of contractions. Two piers yield four contractions, since the sides of the crest opening are considered completely suppressed with the smooth inlet transition employed.

Since shape and length of crest, and number, size, and shape of bridge piers influence the coefficient, the preceding expression is strictly applicable only to the Green Mountain structure. It is useful, however, in determining approximate rating curves for generally similar structures. For very low heads, friction becomes more significant in the model than in the prototype, so the model coefficients are somewhat smaller than those for the prototype for corresponding heads. Prototype measurements are required to determine the relationship between model and prototype coefficients for very low heads.

The efficiency of the bridge piers was determined by removing the piers and calibrating the crest with one opening 80 ft in width. The coefficient is increased only 0.7% to 3.23 for no piers and the maximum head. Figure 2 further shows that the efficiency of the piers decreases with decreasing head.

Operation of the originally designed chute, indicated by dashed lines in Fig. 1, showed that the channel convergence below the gate structure was too rapid, resulting in the transverse-wave phenomenon often encountered in tapered channels. If reproduced in corresponding degree in the prototype, these waves would overtop the originally specified 15-ft-high chute walls. Several smaller angles of convergence were tested and the design shown in Fig. 1, while not completely eliminating the waves, proved satisfactory. The height of chute side walls was increased to 19 ft, providing a minimum freeboard of 7 ft, which allows for considerable entrainment of air in the prototype chute flow. Since rock was encountered at about Sta. 15+00, it was economical to change to a trapezoidal section with $\frac{1}{2}$ to 1 side slopes. A minimum length of transition of 170 ft was required to give satisfactory flow conditions in the lower part of the chute.

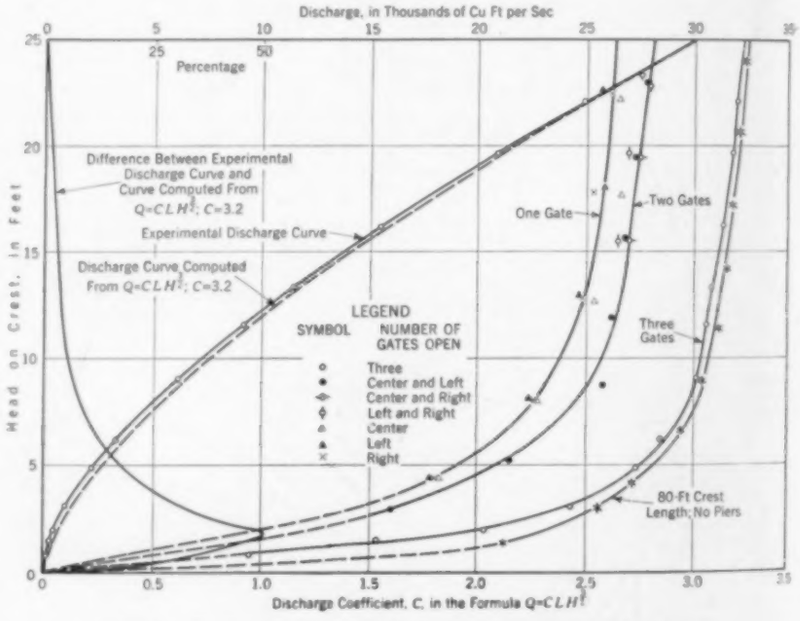

FIG. 2. COEFFICIENT AND DISCHARGE CURVES FOR SPILLWAY

Important to the successful hydraulic operation of a chute is the design of vertical curves. Generally, such curves are introduced to fit the topography. If too sharp, the high-velocity stream will spring from the chute bottom, seriously limiting safe operation. The

theoretical equation for the jet trajectory, based on the mean velocity at the beginning of the curve, is

$$y = -x \tan \theta - \frac{g}{2V_m^2 \cos^2 \theta} x^2$$

where x and y are the horizontal and vertical coordinates with the P.C. of the curve as origin; θ is the angle the chute bottom makes with the horizontal at the P.C.; V_m is the mean velocity in a transverse section at the P.C.; and g is the acceleration of gravity. This equation was used in designing the vertical curve of the Kittitas chute, Yakima project. Recent operation of this chute showed the vertical curve to be entirely too sharp. So much water sprang from the chute that safe operation was limited to about half the maximum design discharge.

To prevent any disruption of the flow, the trajectory should be designed for at least the maximum velocity in the transverse section at the beginning of the trajectory. Assuming a maximum velocity equal to 125% of the mean velocity, the trajectory equation becomes

$$y = -x \tan \theta - \frac{g}{3.13V_m^2 \cos^2 \theta} x^2$$

When a mass of water-air mixture passes over a convex vertical curve at high velocity, the reduction of internal pressure within the mass due to centrifugal action results in an expansion of the air bubbles within the mass and an increase in the tendency toward disruption of the flow. A more conservative design formula would perhaps then be

$$y = -x \tan \theta - \frac{g}{4V_m^2 \cos^2 \theta} x^2$$

All the convex vertical curves for the Green Mountain spillway fall well within the maximum limit given by the latter expression, so satisfactory flow conditions over the curves are expected.

An error is commonly introduced in hydraulic computations for flow in steep chutes by use of the mean velocity in determining kinetic energy. In recent computations a kinetic energy factor, α, has been introduced so that the true average kinetic energy or velocity head is given by $\alpha V_m^2/2g$, where V_m is the mean velocity.

Measurements and computations were made in the model to determine the value of α for high-velocity flow. An apparent experimental energy line was plotted by adding apparent velocity heads, as determined by $V_m^2/2g$, to water-surface elevations along the chute. The true energy line was obtained by subtracting the channel friction loss, as determined by Manning's formula, from the reservoir elevation. The discrepancy between the two lines is a measure of the value of the coefficient α. In computing the hydraulic values in Table I, converted to prototype quantities from model values, no attempt has been made to adjust prototype values for possible difference in prototype and model roughness values, because of the uncertainty of these values and the added effect of entrained air. The point to be noted is that the coefficient α, inherent in the velocity distribution, is important in determining the true energy line for high-velocity flow. A point of interest is that α increases in value as the velocity increases, indicating that the velocity distribution becomes less uniform in a cross section as the velocity increases.

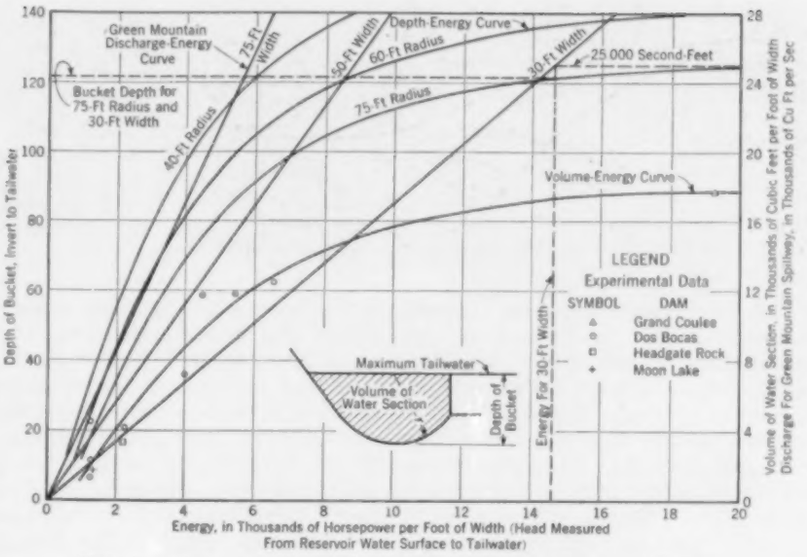
Green Mountain Discharge-Energy Curve
Bucket Depth for 75-Ft Radius and 30-Ft Width
75-Ft Width
50-Ft Width
30-Ft Width
Depth-Energy Curve
25,000 Second-Feet
60-Ft Radius
75-Ft Radius
40-Ft Radius
Volume-Energy Curve
LEGEND
Experimental Data
SYMBOL DAM
Grand Coulee
Dos Bocas
Headgate Rock
Moon Lake
Maximum Tailwater
Volume of Water Section
Depth of Bucket
Energy For 30-Ft Width
Depth of Bucket, Invert to Tailwater
Volume of Water Section, in Thousands of Cubic Feet per Foot of Width
Discharge For Green Mountain Spillway, in Thousands of Cu Ft per Sec
Energy, in Thousands of Horsepower per Foot of Width (Head Measured From Reservoir Water Surface to Tailwater)

FIG. 3. DESIGN CURVES FOR ROLLER-BUCKET STILLING BASIN

The channel of the Blue River at the Green Mountain Dam site is in a solid rock formation, with a 15-ft covering of bed material consisting of a combination of sand and gravel, closely interspersed with larger rock fragments, all intimately associated in a cohesive mass. Because of the improbability of excessive scouring by the high-velocity chute flow, it was considered economical to let the flow shoot out into the river without the use of any type of stilling basin. There was some concern, however, as to the formation of a gravel bar downstream from the power house. Such a bar would raise the tailwater in the power house tailrace, effectively reducing the power head.

TABLE I. HYDRAULIC PROPERTIES OF CHUTE FLOW (25,000 CU FT PER SEC)

STATION	MEAN DEPTH D_m	HYDRAULIC RADIUS R_m	MEAN VEL. V_m	APPARENT VEL. HEAD $V_m^2/2g$	TRUE VEL. HEAD $\alpha V_m^2/2g$	KINETIC ENERGY FACTOR α
10 + 50	10.38	8.24	30.3	14.2	15.0	1.06
11 + 77	7.14	5.80	56.4	49.4	52.6	1.07
14 + 22.19	10.10	6.03	82.5	105.6	123.6	1.17
15 + 94.13	11.25	6.40	86.5	116.2	133.0	1.15
17 + 96	10.20	6.00	97.3	147.0	181.0	1.23
19 + 33	9.76	5.84	102.5	163.2	198.6	1.22

In order to study the erosion of the river bed, it was first necessary to select a material that would suitably represent the natural alluvium. A scouring material representative of the river overburden was thought to be approximated by a mixture of 75% of 1/4 to 1-in. pit-run gravel and 25% of Cherry Creek sand. The sand, scaled to prototype dimensions, would be representative of small pebbles and the 1-in. gravel to 3-ft 4-in. rock. The use of an accurately analogous bed material to obtain reliable quantitative scouring is a practical impossibility, but it was felt that satisfactory qualitative results could be obtained with the selected cohesionless and less stable model material.

A series of tests was made to investigate the formation of the downstream bar and to determine the possible existence of destructive currents at the downstream toe of the earth dam. For no conditions of flood did destructive eddies form at the toe, and scouring occurred well downstream. The resulting bar became higher and moved farther downstream for floods up to 7,500 cu ft per sec. For larger floods, the bed material was carried out of the model. A bar-crest envelope, drawn from the experimental data, became horizontal for a flood of

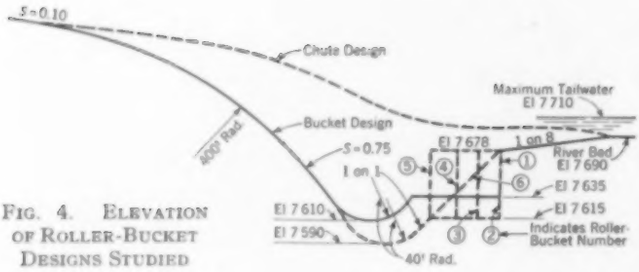

FIG. 4. ELEVATION OF ROLLER-BUCKET DESIGNS STUDIED

about 10,000 cu ft per sec. The significance is that the highest bar will be formed for this flood. For larger floods, bottom velocities over the crest of the bar are sufficiently above the critical value for the bed material to cause the bar to flatten out and not build up as high.

Whether the bar in the prototype will be as high as or higher than that shown by the model, will depend on similarity of scouring action and duration and rate of subsidence of floods. With a slow rate of subsidence, much of the bar may be washed downstream as the downstream water level decreases. The best field plan is to investigate the bar after each flood to determine the feasibility of excavating it to regain the lost power head. Tests showed that when a bar resulting from a previous flood is excavated to the original river bed, a second flood of the same intensity will form a second bar farther downstream but not as high as the first. After several floods of varying intensities, the river-bed overburden will be carried downstream beyond the distance required to produce tranquil flow in the rock channel. Thereafter, with the erodible material beyond reach of the high-velocity stream, further formation of bars need not be anticipated.

TWO TYPES OF STILLING BASIN INVESTIGATED

Because of the possible excessive cost of excavation of bars or loss of power revenue, it was desirable to study the possibility of incorporating a stilling basin to prevent the formation of bars. Both the roller-bucket and the horizontal, hydraulic-jump type of basin were investigated. For the purpose of determining the proper bucket dimensions, a volume-energy curve for satisfactory bucket operation was drawn from available experimental data. This is shown in Fig. 3, together with the depth-energy curves for bucket radii of 40, 60, and 75 ft that were obtained from the volume-energy relationship. Green Mountain discharge-energy curves for several widths are also plotted. The procedure in determining the proper bucket dimensions by the use of these curves is to select a trial bucket width and radius and determine the required bucket depth corresponding to the design discharge and energy. Cost estimates should be made for several trial widths and radii and the corresponding bucket depths, and the proper combination of dimensions to use is the one of least cost.

The design curves are not presented as being conclusive, but merely as a guide in the design of a roller-bucket stilling basin. The experimental data from which they are drawn are far from sufficient, and whether the variables are properly related has as yet not been established. For example, it is not known whether more of the water section should be included in the volume variable and whether the volume-energy relationship is independent of the bucket width.

To check the validity of the design curves, the six designs shown in Fig. 4 were tested in the model. Bucket design No. 1 had the dimensions: 40-ft radius, 100-ft depth, and 30-ft width. Model operation showed this bucket to be satisfactory up to 5,000 cu ft per sec, as compared to 7,000 cu ft per sec given by the design curves. The depth of bucket No. 2 was increased to 120 ft, and its satisfactory operation was 7,500 cu ft per sec compared to 10,000 cu ft per sec given by the design curves. Buckets Nos. 3, 4, 5, and 6 have the same principal dimensions as No. 2, but the shape of excavation beyond the end of the bucket is different for each. All these designs were inferior to No. 2, No. 6 being definitely the poorest. These tests indicate that extent and shape of excavation beyond the end of the bucket influence required bucket dimensions.

From the design curves, a bucket 30 ft wide would require a radius of 75 ft and a depth of 121.5 ft to operate satisfactorily for the maximum design flood of 25,000 cu ft per sec. Studies showed the cost of any bucket to be excessive, so no further consideration was given this type of design.

The horizontal, hydraulic-jump type of stilling basin was next studied. No model tests were made of this type, however, since reliable data from previous studies of other structures could be utilized in determining rather closely the required principal dimensions for the Green Mountain conditions. The required sizes of rectangular basins for 30, 50, and 90-ft widths are shown in Fig. 5. Again, the proper basin width must be determined by a cost analysis. Although the cost of the horizontal basin would be considerably less than that of the roller-bucket basin, it also was considered to be excessive.

Comparison of the two types of stilling basins leads to the conclusion that the selection of type depends mainly on the tailwater conditions prevailing at the dam site. The depth of water required in the roller bucket for satisfactory operation is considerably more than that required to form a good jump in the horizontal basin. When the height of tailwater above the river bed is much in excess of the required jump depth for a horizontal basin, better flow conditions will exist in the roller-bucket basin, and in some cases the cost will be less. When the height of tailwater above the river bed is less than the required jump depth, the horizontal stilling basin should be used, since the cost in all cases will be less.

The Green Mountain Dam, now under construction, is a unit of the Colorado–Big Thompson Project, Colorado. (For a general description of this project see the article by Porter J. Preston, M. Am. Soc. C.E., in the August 1938 issue of CIVIL ENGINEERING.) The study described in the present paper was made in the hydraulic laboratory of the Bureau of Reclamation, Denver, Colo., under the immediate supervision of the writer and general direction of J. E. Warnock, research engineer. All laboratories are under the supervision of Arthur Ruettgers, senior engineer, and R. F. Blanks, engineer. All design work is under the general supervision of J. L. Savage, chief designing engineer. All engineering work is under the direction of R. F. Walter, chief engineer; and all activities of the Bureau are under the direction of John C. Page, Commissioner.

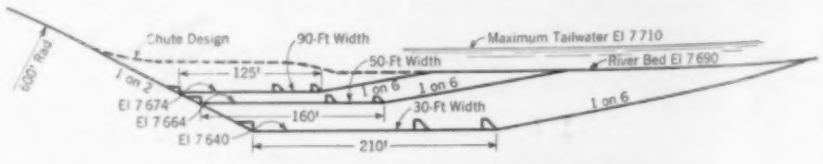

FIG. 5. ELEVATION OF HORIZONTAL STILLING BASINS

The Port of New York—Organization and Control; Navigation Projects

By C. L. Hall

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THIS is the first of a series of articles on the organization and operation of the Port of New York, originally presented as a symposium before the Waterways Division at the 1940 Annual Meeting. In it Colonel Hall describes the physical layout of the port, outlines briefly the interrelationships of various governmental agencies that have a part in its control, and gives particular attention to the work of the Corps of Engineers in developing and maintaining the waterways within the port limits. Succeeding articles by other writers will deal with other phases of the general topic.

ALTHOUGH the Port of New York is blessed by a number of natural advantages, no single feature is so marked as to have made its selection as a metropolis inevitable. It is a safe haven, but no safer than Portland, Me., or Norfolk, Va. It has a magnificent hinterland, but right now the natural hinterland is smaller than that of either Baltimore or Philadelphia. It is an excellent place for transfer from ocean boat to smaller vessel, but not as good a one as New Orleans. As a point of natural transfer from water to land the island of Manhattan, the heart of the Port of New York, is physically inferior, by nature, to any number of Atlantic ports.

But in the early years of the last century, a group of men had a vision. Their leader, DeWitt Clinton, grasped the fact that the city was cut off from the west by a chain of mountains, and that the place where the most economical route from the west struck the sea would gain such an immediate lead that its metropolitan character would be assured forever. The building of the Erie Canal fixed the position of the nation's metropolitan port for the generation which elapsed from the date of its construction until the use of railroads became general. By the latter date, about 1850, New York had become the country's premier port. That proud rank it has never lost.

The Port of New York, as defined by the district limits of the Port of New York Authority (Fig. 1), embraces an area approximately 20 miles in radius about Manhattan Island. Threaded by numerous waterways, it has a total water frontage of some 770 miles and a developed frontage of about 350 miles. Twelve railroads and a vast network of highways provide communication with the interior. The Hudson River with the State Barge Canal system provides water transportation to the Great Lakes and to the west. An entrance at Throgs Neck opens on Long Island Sound and the coastwise trade of New England. The main entrance to the port at Sandy Hook opens on the Atlantic Ocean and the foreign trade of the world. Some ten million people live and work within this port district.

To facilitate the movement of traffic within the port, vast sums have been expended by both private and governmental interests. Crossing the waterways of the port are approximately 135 bridges, ranging in size from the menial trolley bridge of 30-ft span to the George Washington Bridge of 3,400-ft span; and in some 19 places not adaptable to bridges, tunnels have been used. Facilities for water transportation have been kept abreast by the deepening and widening of some 40 waterways, and the extensive development of terminals.

Today the Port of New York handles about 50% by value of all the foreign commerce of the nation, and the gross volume of all water-borne commerce in the port, including foreign, coastwise, internal, and intraport traffic, is about one-fifth of that handled at all ports of the United States. Specifically, in 1938, the gross volume of water-borne commerce of the Port of New York amounted to 182,000,000 tons. Of this, 63,000,000 tons were foreign and domestic, and 119,000,000 tons were intraport.

The sporadic distribution of this commerce through the port area (Fig. 2), and the comparatively great volume of intraport commerce, are symptoms of one of the major problems of the port. The segregation of land areas by the many waterways, though splendid from the standpoint of navigation, presents a natural barrier to the free flow of land traffic within the port. The majority of the railroads terminate, necessarily, on the mainland along the west side of the harbor. Living and working facilities, however, have concentrated the population with its accompanying vast market possibilities on the east side of the port. The ultimate result has been a vast transshipment of goods from rail to water, then back from water to rail or truck before reaching the consumer. Outgoing and incoming cargoes are subject to the same inefficiency, as they are assembled or broken up at all parts of the port.

One feature that has tended to augment this inefficient condition has its origin in history. The rapid growth of the port in the hands of private competitive enterprise occurred during a period of national development when jurisdiction and control were sorely limited. The port just grew in "Topsy" fashion. What jurisdiction there was in the past was vested primarily in small local governments, of which there are legion within the port district. As a consequence, competitive terminals, services, and the like exist side by side, further necessitating the breakdown of cargoes and transshipment for reassembly. Thus we have intraport figures making up a disproportionately large part of the port's commerce. The inefficiencies that exist are clearly evidenced by the com-

Todd Shipyards Corp. and Fairchild Aerial Surveys, Inc.

One of the Largest Marine Repair Plants in the Port—Robins Dry Dock and Repair Company

The *S.S. Manhattan* Is in the 731-Ft Graving Dock on the Left

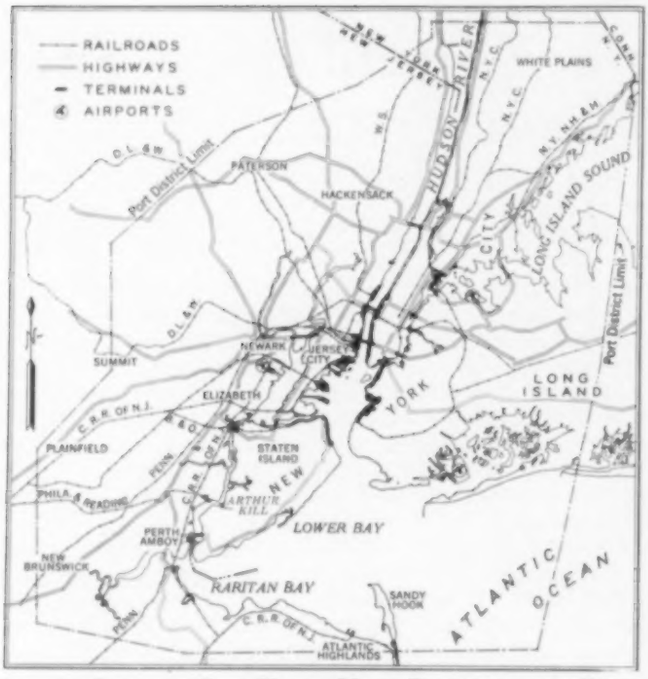

FIG 1. PORT OF NEW YORK—MAIN TRANSPORTATION LINES

paratively slow movement of traffic through the port and by the high costs that obtain.

The organization of the port today consists of what might be said to be a countless number of private interests, with their activities covered by overlapping layers of governmental apparatus. To understand them would be difficult for the traditional Philadelphia lawyer. Private interests include shipping, shipbuilding, and ship repair, railroads with their terminal and car-floatage features, lighterage and towboat interests, trucking, private terminals, stevedoring, and miscellaneous services. Interlocked with these are the financial and banking institutions, as well as the factories, with their own diversity of interests.

CONTROL OF PORT VESTED IN THREE TYPES OF AGENCIES

Control of the operation of the port today, without curtailing the rightful liberties of private enterprise, is accomplished by federal, state, and municipal agencies. It would be an endless task to attempt an exhaustive classification of these agencies. A few of those whose functions might be described as typical have been somewhat arbitrarily chosen, however, and set up in Table I. Their functions I have attempted to restrict to those related to commerce as a whole and to its movement by water, land, or air, and also its transfer. The classification is then restricted to the three broad headings of "Regulation," "Improvement," and "Aid." Under "Regulation" are included supervisory and administrative functions, enforcement of law, policing, etc.; under "Improvement" are included such activities as construction and maintenance of works directly within the port; and under "Aid" are included such services as are of direct benefit and assistance to private enterprise in the course of its work. That this classification is a rather loose one must be granted.

Of the agencies enumerated, 13 are federal and 6 are state. No attempt has been made to enumerate the municipal agencies. Regulatory power is exercised by 8 federal and 4 state agencies; improvement work is carried on by one federal and 3 state agencies; and assistance is provided by 6 federal agencies.

The most important development in recent years has been the establishment of the Port of New York Authority by compact, made in 1921, between the states of New York and New Jersey. Here, for the first time, it can be said, a single body is actively engaged in the development of the port as a unit. Its primary function, right now, is the improvement of land traffic and terminal facilities through actual construction work. Another function, of no less importance, is the promotion of unified effort on the part of all toward a more efficiently operated port.

That the bulk of the improvement work in the port has fallen to the lot of municipal authorities is to be expected. The City of New York has constructed some 274 piers along its waterfront, of which the three new 1,100-ft piers on the Hudson River are outstanding. The latter represent an investment of $11,000,000, and provide berthing facilities for the largest ocean liners afloat, a service not duplicated anywhere else in the United States. The City of Newark is operating the Port Newark Terminal on Newark Bay, which might be said to be a port within a port. The City of Bayonne has recently completed a large general merchandise terminal in the Upper Bay. Finally, two large airports have been built by the City of New York, and one by the City of Newark, to meet the demands of modern air transportation. These are but a few of the outstanding municipal enterprises that are contributing to the development of the port.

This very brief résumé of the organization of the Port of New York indicates its intricacy. In the remainder of this article I shall discuss in some detail the functions of the Corps of Engineers in connection with it.

FUNCTIONS OF THE CORPS OF ENGINEERS

The Corps of Engineers, in prosecuting an improvement, works under what is known as a federal project. A waterway improvement is first proposed by local interests to their Congressman. Congress, in turn, scrutinizes the proposal quite liberally, and, if it has the virtues claimed for it, includes an item calling for the examination of the proposal in a forthcoming River and Harbor Act. Here is the first time the Corps of Engineers enters the picture. A rough examination is first made at little expense, and if the proposal has any economic merit, the Chief of Engineers orders a detailed study to be made. This study and report, known as a "Survey Report," includes a detailed cost analysis with definite recommendations for improvement based on the probable beneficial effect it will have on navigation and commerce. Often, when the estimated cost falls short of the possible benefits to the public, a contribution in the form of money, rights of way, or parallel improvement is required of local interests before a favorable recommendation is made. It is this report which, receiving the approval of Congress, becomes the basis of a federal project. Upon appropriation of funds for river and harbor work, the Corps steps in and accomplishes the improvement, either by contract or by its own forces.

Federal projects in the Port of New York date back to the River and Harbor Act of August 30, 1852, which provided for the removal of rock obstructions in Hell Gate and for the removal of a shoal in Newark Bay. From 1868 to 1890, 27 new projects were authorized, and since 1890 the increase has been fairly uniform. Today there are 40 federal projects within the port, providing for the improvement of 238 miles of waterway, or about 75% of the mileage of all the navigable waterways in the port. Project depths, based on mean low water, vary from 3 to 48 ft, and widths vary from 50 to 2,000 ft. Of these improved waterways, 124 miles, or about 50%, have been provided with depths greater than 30 ft for the use of

ocean-going vessels; 65 miles, or 25%, have been provided with depths of 8 to 12 ft, essentially for local and intraport traffic. The cost of this work has been great. For the original construction of these channels $99,000,000 has been spent, and maintenance has cost another $13,000,000.

PORT WATERWAYS COMPRISE HUGE NETWORK

One might be prone to ask how $112,000,000 could be spent on the waterways of a section but 20 miles in radius. Let us look at these waterways in perspective. First, there are four large arteries in the port requiring depths of 35 ft or greater for the larger ocean-going vessels. These are New York Harbor proper, with its channels generally 40 ft deep to provide entrance to the port; then there are the Hudson and East rivers, 35 to 40 ft deep, to serve the heart of the industrial and commercial area; and then the newly prominent New York and New Jersey Channel, 30 to 35 ft deep, to meet the demands of a rapidly growing new industrial area. Of somewhat lesser importance, yet still in the arterial category, are three 40-ft channels serving the Brooklyn waterfront. From all these spring some 30 other waterways of diminishing importance, yet nevertheless necessary to reach into the interior.

The dredging of these channels has involved the removal of all types of material ranging from the hardest of trap rock, now being encountered in the New York and New Jersey Channel, to silt so fine that as much is washed overboard as is retained in the hoppers.

Of the large rock jobs, the East River project is prominent, not only from the standpoint of quantity of rock, roughly estimated as 1,500,000 cu yd, but from the standpoint of being started at a time when submarine rock removal was in its embryo stage in this country. In its original condition the East River was a sinuous tidal strait having a navigable channel of about 26-ft depth for widths less than 500 ft. In Hell Gate, the worst section of the waterway, only three narrow channels varying from 100 to 200 ft in width and 19 to 26 ft in depth were available. There were 33 rock shoals throughout the waterway, 11 of which were in the $1^1/_2$-mile reach of Hell Gate. Current velocities in Hell Gate were as high as $8^1/_2$ knots, making navigation of this section hazardous to the point where it was estimated that one vessel out of every fifty attempting to pass through it met with some mishap.

When work was started in 1852 for the removal of the rocks in Hell Gate, surface blasting, introduced by a Frenchman named Maillefert, was first tried. This proved ineffective as soon as the pinnacles were reduced to a broad face. An improvised drill-boat consisting of a scow rigged with drills made its appearance in 1870. This means, though effective in other reaches of the river, could not stand up against the fast current in Hell Gate.

DREDGING AND ROCK REMOVAL OPERATIONS IN NEW YORK AND NEW JERSEY CHANNEL

Dredges in Background and at Right; Multiple-Frame Drill-Boats in Center Foreground and at Left

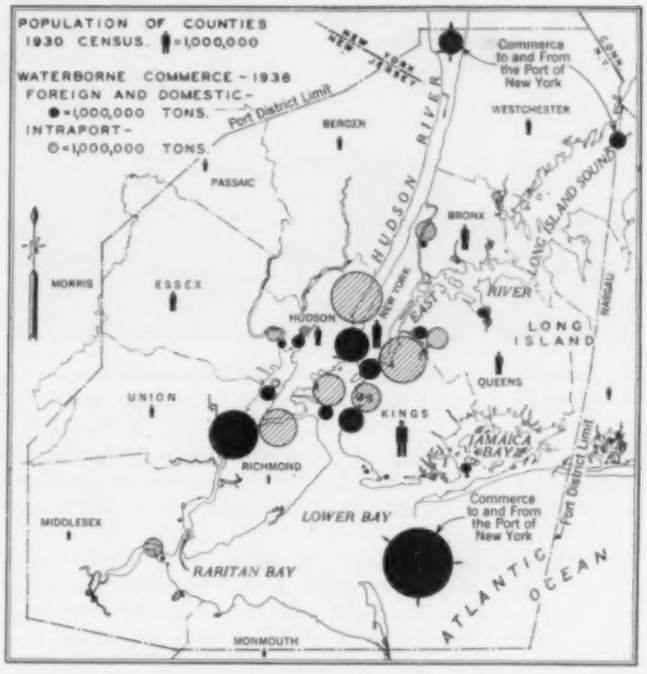

FIG. 2. DISTRIBUTION OF POPULATION AND GROSS WATER-BORNE COMMERCE

In 1869, the novel expedient of driving a shaft from the shore, undermining, and then blasting was resorted to. This was tried with some success on two large shoals. Thereafter, either through already reduced current velocities or better drill-boat equipment, the work was carried on from the surface. From the makeshift drill-boat of 1870, there has been developed in the course of work on this improvement, the large, highly efficient, multiple-frame drill-boat of today.

The East River, now completed, has been thus transformed from a treacherous, unsafe waterway into one of commodious size. Forty feet of water is available up to the Brooklyn Navy Yard, and 35 ft throughout to Long Island Sound. Widths are generally 1,000 ft, and in the Hell Gate section current velocities have been reduced from the previous $8^1/_2$ knots to less than 5 knots.

We are confronted with an entirely different condition in improving the entrance channels in New York Harbor. Here large ocean bars had to be cut through, involving the removal of millions of yards of silt, sand, and gravel. When the improvement was first started in 1884, it was apparent that the grappling devices of that day were wholly inadequate for work of this magnitude. We therefore find, through a period of years, the development of the sea-going hopper dredge, of which the *Goethals* marks the present peak. Built by the government in 1937, at a cost of $3,500,000, it is the largest of its type in the world. It has a bin capacity of 5,000 cu yd. Compare this with the 817-cu yd bin capacity of the *Reliance* built by a contractor, Mr. Edwards, about 1888 for work on the Mainship, Bayside, and Gedney channels. The *Reliance* was one of the first boats actually to operate on the principle of the present sea-going hopper dredge. It was purchased by the government in 1892, and in 1902 Congress authorized the construction of two other dredges of the sea-going type. Since that time work requiring the use of this type of plant has become primarily a governmental venture.

Since 1884, there have been expended $8,700,000 for new work and $2,200,000 for maintenance for the entrance channels in New York Harbor. There have been

UNITED STATES SEA-GOING HOPPER DREDGE *Goethals*
Largest of Its Kind, It Has a Bin Capacity of 5,000 Cu Yd

provided a main entrance (Ambrose Channel) having a depth of 40 ft and width of 2,000 ft, and a subsidiary entrance with a depth of 35 ft in two channels and 30 ft in a third.

Of the Hudson River improvement, I would only mention that it was primarily a soft-material job with the exception of a few small rock shoals at the entrance. In its original condition large mud flats lay along the Jersey shore up to about West 19th Street. These flats had much to do with the concentration of shipping along the Manhattan waterfront, where a channel 40 ft deep and 1,000 ft wide was available. Dredging operations carried on from 1875 at a cost of $5,900,000 for new work and $1,800,000 for maintenance, have provided 40 ft of water for the full width of the river up to West 59th Street. Beyond that point and along the Weehawken-Edgewater waterfront a 30-ft channel has been provided.

The New York and New Jersey Channel, on which $3,000,000 is at present being spent annually, is another costly rock job of a nature somewhat similar to that in the East River. Here, 35 ft of water is to be achieved from the ocean, around Staten Island to Upper Bay, with the exception of a 7-mile reach in Arthur Kill, which will remain at a previous project depth of 30 ft. In the upper section—that is, in Kill Van Kull and the upper part of Arthur Kill—rock predominates. The lower section is a soft-material job. The sea-going hopper dredge *Goethals* is now operating in the Raritan Bay section taking out as many as 500,000 cu yd per month. To June 30, 1939, $24,600,000 has been spent for new work and $1,000,000 for maintenance on this project.

Have any of these projects which I have so briefly mentioned been completed? Yes and no. Projects for improvements, particularly in the larger works, are virtually always under change to keep pace with the port. The uncompleted, yet authorized, work totals some $30,000,000, and in the past five years expenditures have averaged annually about $3,700,000. To say when one will catch up with the other will be to say when the Port of New York will stop growing.

Although dredging is the largest item in river and harbor work, there are other activities of no little importance For the protection of an improvement the Corps of Engineers has vested in it regulatory power over any action which might affect a waterway's navigability. To protect the waterways against undue encroachment of the waterfront, the War Department has established what are known as pierhead and bulkhead lines. These are now established under the River and Harbor Act of 1899, which further prohibits construction of any bridges, dams, dikes, causeways, or other obstructions to navigation over or in any navigable waterway of the United States without War Department approval of the plans.

One might question how the Department, whose sole interest lies in navigation, can control the erection of waterway structures without seriously infringing on the rights of other interests. This is truly a problem that must be solved by compromise. Let us take for example the Central Railroad of New Jersey Bridge over Newark Bay. Excessive grade requirements with high cost would have made construction of a fixed bridge undesirable, yet the type and extent of waterway traffic demands clearance. The compromise was achieved by having two lift spans installed of adequate clearance and subject to War Department regulations as to the frequency of bridge openings. Though obviously inconveniencing waterway traffic, these regulations are the lesser evil.

While the officers of the Corps of Engineers have been in responsible charge of the engineering development of the waters of the port for almost a century, they have been continuously assisted—in every aspect of their work—by engineers in civil life. One of these aspects is, incidentally, the preparation of this paper. Indeed, one of the greatest successes of the Corps has been its ability to maintain this magnificent civil service organization, free of political control, for so many years. Where we have succeeded, it is largely due to its help. Where we have erred, it has been our responsibility.

TABLE I. PRINCIPAL FUNCTIONS OF SOME GOVERNMENTAL AGENCIES IN THE PORT OF NEW YORK

Reg. = Regulation; Imp. = Improvement; Aid = Services or Assistance

	Commerce		Movement of Commerce			
Agencies	Foreign	Domestic	Water	Land	Air	Transfer
Federal:						
Bureau of Customs	Reg.	....	....	....	....	....
Coast Guard	....	....	Reg.-Aid	....	....	....
Lighthouse Service	....	....	Aid	....	....	....
Public Health Service	Reg.	Reg.	....	....	....	....
Corps of Engineers	....	....	Reg.-Imp.	....	....	....
Navy (Hydrographic Office)	....	....	Aid	....	Aid	....
Weather Bureau	....	....	Aid	Aid	Aid	....
Coast and Geodetic Survey	....	....	Aid	....	Aid	....
Bureau of Marine Inspection and Navigation	....	....	Reg.	....	....	....
Immigration and Naturalization Service	Reg. (Pass.)	....	....	....	....	....
Interstate Commerce Commission	....	Reg.	Reg.	Reg.	Reg.	....
Civil Aeronautics Authority	....	....	....	....	Reg.-Aid	....
Foreign Trade Zones Board	....	....	....	....	....	Reg.
State of New York:						
Dept. of Public Works	....	....	....	....	....	Imp.
Dept. of Public Service	....	....	....	Reg.	....	....
Pilot Commission	....	....	Reg.-Aid	....	....	....
State of New Jersey:						
Board of Commerce and Navigation	....	....	Imp.-Reg.	....	....	Imp.-Reg.
Pilot Commission	....	....	Reg.-Aid	....	....	....
States of N.Y. and N.J.:						
Port of New York Authority	....	....	....	Imp.	....	Imp.
Municipalities:						
Through various depts.	....	....	Imp.-Reg.	Imp.-Reg.	Imp.-Reg.	Imp.-Reg.

The Conquest of the Continental Divide

Second of Three Articles on Railway Routes Across the Rocky Mountains

By RALPH BUDD

MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS
PRESIDENT, CHICAGO, BURLINGTON & QUINCY RAILROAD, CHICAGO, ILL.

TODAY there are thirteen major crossings of the Rockies on the routes of nine transcontinental railways. Mr. Budd here discusses the routes from the Mexican border to and including the Northern Pacific, and incidentally gives some interesting information about Rocky Mountain passes that have never been used by a railway, and in his opinion never will be. The rugged character and broad expanse of the Great Range is shown by the fact that the railway crossings frequently entail summits hundreds of miles east and west of the continental divide, which are higher than the divide itself. This article, together with that by Mr. Budd in the February issue, and one to appear in April, constituted the annual dinner address for 1938 of the American Branch of the Newcomen Society.

IN 1869 the first rails were connected across continental America when the Union Pacific and Central Pacific tracks met at the summit of Promontory Point, north of Great Salt Lake. Other lines followed, to the north and to the south, and soon the railways were carrying the settlers to the intermountain and Pacific slope country as they had carried them over the Alleghenys and into the Middle West a generation or two earlier.

In crossing the divide the railroads followed generally routes covered by the Pacific Railroad Reports, dealt with in my previous paper in the February issue. It is interesting here to consider some of the characteristics of the railroad lines which actually use the passes of the Rocky Mountains at the present time. (See Table I and Figs. 1 and 2.)

SOUTHERN PACIFIC

The Southern Pacific has the lowest continental divide summit in the United States, but, like some of the other Rocky Mountain crossings, the elevations at widely distant points, east and west of the divide itself, are higher than that summit, which separates the waters of the two oceans. Through the most southerly gateway, El Paso, focal point of travel since 1598, the Sunset Route from New Orleans and Houston, the Sunshine Route from St. Louis, Dallas and Fort Worth, and the Golden State Route from Chicago and Kansas City, converge from the east and follow thence the alternative paths of the Southern Pacific Railway westward across the continental divide. Of these two alternatives the first, completed in 1883, follows up Rio Grande drainage on a grade of 1.0%, crosses the divide in the open near Lordsburg, N. Mex., at El. 4,244 ft, and descends the west slope on a 1.0% grade in Gila River drainage. About 90 miles west of Lordsburg is Dragoon Summit, at 4,613 ft, with a 1.1% grade on its east slope and a 1.4% on its west slope leading down to the San Pedro River. There is also a 1.4% ascending grade westward from the San Pedro to Mescal. The other line, about twenty miles to the south of the first, was built in 1902 as the El Paso and Southwestern. It ascends westward from the Rio Grande on a grade of 1.0%, crosses the divide in the open at El. 4,488 ft near Antelope, N.Mex., and descends on a 1.0% grade in the drainage of the Gila. A few miles to the east of Lordsburg and Antelope both of these tracks attain elevations some 300 ft higher than at those passes, and there is a question as to the exact location of the continental divide in this latitude. About 300 miles still farther east the Sunset, Sunshine, and Golden State routes attain altitudes of 5,074, 4,550, and 6,666 ft, respectively.

From El Paso westerly for 560 miles, both Southern Pacific lines run the length of the Gadsden Purchase of 1853. In fact this purchase, which settled the Mexican boundary question, was made largely because of the knowledge that the important passes to which El Paso is the eastern gateway, lay within the disputed area. James Gadsden, who as Minister to Mexico, negotiated the purchase, had been President of the South Carolina Railroad, and was an ardent advocate of a "railway to the Pacific along the southern frontier," through the passes at the headwaters of the Gila.

SANTA FE AND RIO GRANDE

About 250 miles to the north is the famous route of the Atchison, Topeka and Santa Fe Railway. Following up Rio Grande and Rio San Jose drainage on a 0.6% grade, it crosses the continental divide in the open at Campbell Pass (so named for A. H. Campbell of one of the Pacific Survey parties), El. 7,247 ft, at Gonzales, N.Mex., and descends in Rio Puerco–Colorado River drainage on a 0.6% grade. Here again the continental divide is not the highest point of the Rocky Mountain crossing. There is a summit 200 miles west of Campbell Pass where the line crosses what is called the Arizona Divide near Flagstaff, El. 7,354 ft, with 1.42% grades from both directions, except for a few miles of 1.8% on the west slope.

The Santa Fe was completed from Kansas City to the coast in 1884. It now has two lines from the east which join about 100 miles east of Campbell Pass. The northerly follows the Old Santa Fe Trail via Raton and

Santa Fe Railway Photograph

TUNNELS AT RATON PASS, SITE OF HISTORIC STRUGGLE BETWEEN THE SANTA FE AND THE RIO GRANDE IN 1878
Train, on Lower Track, Is Westbound

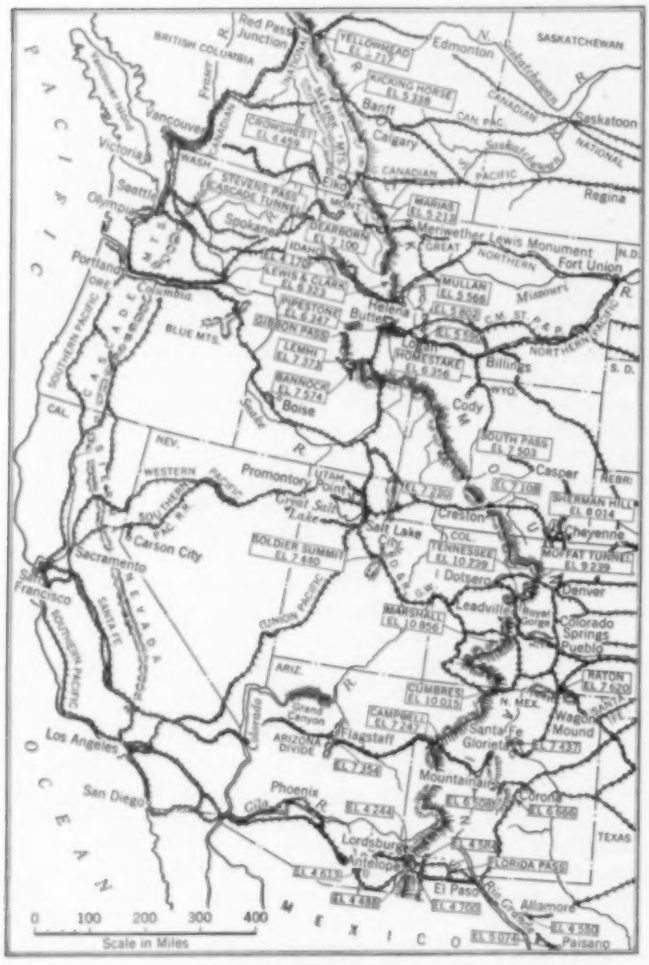

FIG. 1. ROCKY MOUNTAIN REGION, SHOWING PASSES AND RAILROAD ROUTES

Glorieta passes, in spurs of the main range, at Els. 7,620 and 7,437 ft, respectively; the southerly, via Clovis, N.Mex., crosses a ridge between the Pecos and Rio Grande near Mountainair, El. 6,508 ft, using a 0.6% grade on the eastern, and 1.25% on the western slope. The heavy through freight traffic moves over this line, while the passenger traffic goes mostly via Raton and Glorieta. A third line through Clayton, N.Mex., is under construction and follows closely the Short Cut or Cimarron Branch of the Santa Fe Trail.

Next to the north are the two routes of the Denver and Rio Grande Western Railroad in high and rugged parts of the Rockies. The first follows up the valley of the Arkansas River from Pueblo through the Royal Gorge on a grade of 1.42%, crossing the divide beyond Leadville through Tennessee Pass tunnel, at El. 10,239 ft, thence down Eagle River on a grade of 3.0% to the Colorado. The second follows up Ralston and Boulder creeks on a 2% grade from the South Platte River at Denver, crossing the divide through the Moffat Tunnel at El. 9,239 ft, thence down to the Colorado River on a 2.0% grade. This line connects with the Tennessee Pass line at Dotsero, the 40-mile link along the Colorado River from Bond (Orestod) having been built in 1934, thereby forming what probably is the last transcontinental route ever to be carried across the Rockies. Moffat Tunnel is the farthest east of all the crossings of the continental divide, and its eastern approach leads directly from the great prairies of eastern Colorado, Nebraska, and Kansas. The Wasatch Range, which lies between the Colorado River and Great Salt Lake, is crossed by the Denver and Rio Grande Western 400 miles west of Moffat Tunnel at Soldier Summit, El. 7,440 ft, using a 2% grade on the west slope and 2.4% on the east.

The destiny of a railway seems to have been more nearly or more certainly determined by the Santa Fe's victory over the Denver and Rio Grande in the fight for possession of Raton Pass in 1878, than in any other such instance in America, and here, be it noted, the contest did not concern a continental divide crossing, but an important pass on a route leading to the divide. The loss of Raton Pass turned the Denver and Rio Grande from Southwest conquest, perhaps from ultimately reaching Southern California, to Leadville and other Colorado mining centers in the high Rockies, and eventually to Salt Lake City, which it reached in 1883. This railroad, consisting of 2,300 miles, is located wholly in the Rocky Mountain region. At Pueblo and Denver its chief connections are the Missouri Pacific, Rock Island, and Burlington Lines, while at Salt Lake City and Ogden they are the Western Pacific, Southern Pacific, and Union Pacific.

UNION PACIFIC

North of the Denver and Rio Grande Western is the Great Central Route known since the early 1800's from reports of trappers, traders, missionaries, Mormons, Oregon Overlanders, and California Forty-Niners. Here the Union Pacific Railway went through a high but favorable and open country to connect in 1869 with the Central Pacific. Later its lines were extended south to Southern California and north to the Pacific Northwest, but all the traffic flows, hourglass fashion, through one Rocky Mountain summit at Creston, Wyo., at 7,108-ft elevation. Here the continental divide is so wide and open and easy of access that many railways could be built over it without interference, and in fact more than one such project has been launched and surveys made for lines. It was not because of engineering difficulties or physical obstacles that none was undertaken.

Eighty miles to the northwest from Creston is South Pass, at about 7,500-ft altitude, long regarded as the most eligible crossing of the Rocky Mountains. It is at the north edge of the extensive divide plateau, while Creston is at the south edge. No railway ever was built through it, and it seems certain that none ever will be. Considering the extensive use of South Pass by pre-railroad travelers one cannot help wondering why. An important factor is that the early trails led to the Columbia River, and not to California, because until 1848 California was foreign territory, while Oregon was open to joint occupancy from 1818 until it became a part of the United States. South Pass was on the direct road to Oregon, the Oregon Trail. When the Union and Central Pacific railways came to be built in the late sixties, their western terminus was California, not Oregon, and South Pass was too far north of the direct line to California to justify its use, especially since it was desirable to keep the location as near to Denver as practicable, Denver being then, as it is now, the largest city between Omaha and San Francisco. A very satisfactory route was found through Cheyenne, 110 miles north of Denver, and from there a much shorter line than the one through South Pass was available directly to the west, although it does involve high country at Sherman Hill. When the Oregon Short Line was built to the Columbia River from a junction with the Union Pacific, the logical location for such junction was many miles west of South Pass, leaving it again, and apparently forever, without a railway. The immigrant wagon road had to follow streams as closely as

possible, but a railway may go across country. From the North Platte River, near the present city of Casper, the Sweetwater led directly up to South Pass, where less than a mile separates it from the headwaters of Pacific Creek. This was the path of the pioneers to Great Salt Lake, Oregon, and California.

As in other crossings, the continental divide is not the highest point on the Union Pacific. Westward from the plains its route is up Lodge Pole Creek in South Platte drainage, over Sherman Hill at El. 8,014 ft, thence in North Platte drainage down to the Laramie and along that stream and the Medicine Bow to a high plateau some 100 miles in width and almost 300 miles in length from east to west. The continental divide is in this plateau and is crossed by the railroad at Creston, El. 7,108 ft, with 0.82% grades on both slopes. The drainage to the east flows into the North Platte, and to the west into Green River. Crossing Aspen Ridge 200 miles west of Creston at Aspen Tunnel, El. 7,230 ft, between Green River and Great Salt Lake, the grades are 1.14% on the west slope and 0.82% on the east slope. Ascending Sherman Hill, 170 miles east of Creston, the grades are 1.55% on the east slope and 0.82% on the west slope.

NORTHERN PACIFIC AND MILWAUKEE

The Northern Pacific Railway was built through Helena in 1883, following the Missouri River, thence up Ten-Mile and Seven-Mile creeks on a 2.2% grade, crossing the divide through a tunnel at Mullan Pass at El. 5,566 ft, and down the west slope along the Little Blackfoot River on a 1.4% grade to Clark Fork, eventually reaching the valley of the Columbia. Mullan Pass was named for Lieutenant, later Captain, John Mullan, of Governor Stevens' party. In 1858 and following years he built a military road through it, known as the Mullan Road, extending 624 miles from Fort Benton on the Upper Missouri to Fort Walla Walla on the Columbia.

The second, and southerly, line of the Northern Pacific was built through Butte in 1890. This line follows up Jefferson River, a tributary of the Missouri, and Pipestone Creek on a 2.2% grade, crossing the divide through a tunnel at Homestake Pass, El. 6,356 ft, thence down the Clark Fork Valley through Butte on a 2.2% grade.

Mullan Pass, at El. 5,566 ft, is about 800 ft lower than Homestake, and having easier approaches is used for heavy freight movements. The reason for the Northern Pacific's two lines, of course, is that both Helena and Butte are important cities, and each sits by a mountain saddle, Mullan Pass and Homestake Pass, respectively. The Northern Pacific crosses the north end of the Gallatin Range, altitude 5,590 ft in Bozeman Tunnel, 100 miles east of Helena, with a 1.8% grade on the east slope and a 1.9% on the west slope. This is the divide between the Yellowstone and Missouri rivers.

During the years 1906 to 1909, the Chicago, Milwaukee and St. Paul Railway built across the Rockies, closely paralleling the Northern Pacific for many miles. It follows up the Missouri and Jefferson rivers and Little Pipestone Creek on a grade of 2.0%, crossing the divide through Pipestone Tunnel, El. 6,347 ft, a few miles from Homestake, thence through Butte and down the west slope on a 1.7% grade along Clark Fork. About 125 miles east of the continental divide this line crosses the Belt Mountains at altitude 5,802 ft, with a 1% grade on the west slope and a 2% on the east slope. It crosses the Bitter Root Mountains about 250 miles west of the continental divide at altitude 4,170 ft, using 1.7% grades in both directions.

TABLE I. RAILROAD CROSSINGS OF ROCKY MOUNTAIN SYSTEM

Railroad	Summits West of Continental Divide					Continental Divide				Summits East of Continental Divide				
	Name or Location of Summit	Miles West of Divide	El. in Feet	% Grade on West Slope	% Grade on East Slope	Point at or Near Which R.R. Crosses Divide	El. in Feet	% Grade on West Slope	% Grade on East Slope	Name or Location of Summit	Miles East of Divide	El. in Feet	% Grade on West Slope	% Grade on East Slope
Southern Pacific	Dragoon, Ariz.	94	4,613	1.4	1.1	Lordsburg, N.Mex.	4,244	1.0	1.0	Corona, N.Mex. (Golden State Route)	352	6,666	1.0	1.0
										Paisano, Texas (Sunset Route)	357	5,074	1.0	1.0
										Allamore, Texas (T&P Sunshine Route)	261	4,550	1.3	1.3
	Bisbee Junction, Ariz.	96	4,674	1.0	1.0	Antelope, N. Mex.	4,488	1.0	1.0					
Santa Fe	Arizona Divide, Ariz.	219	7,354	1.8	1.42	Campbell Pass, N.Mex.	7,247	0.6	0.6	Raton Pass, N.Mex.	383	7,620	3.3	3.5
										Glorieta Pass, N.Mex.	212	7,437	3.0	1.7
										Mountainair, N.Mex. (freight)	160	6,508	1.25	0.6
D. & R. G. W.	Soldier Summit, Utah (Wasatch Mts.)	370	7,440	2.0	2.4	Tennessee Pass Tunnel, Colo.	10,239	3.0	1.42	None	Via Pueblo			
		422	7,440	2.0	2.4	Moffatt Tunnel, Colo.	9,239	2.0	2.0	None	Via Denver-Dotsero Cutoff			
Union Pacific	Aspen Tunnel, Wyo.	190	7,230	1.14	0.82	Creston, Wyo.	7,108	0.82	0.82	Sherman Hill, Wyo.	171	8,014	0.82	1.55
Northern Pacific	Evaro, Mont. (Passenger Line)	116	3,971	2.2	2.2	Mullan Tunnel, Mont. (Via Helena)	5,566	1.4	2.2	Bozeman Tunnel, Mont. (Gallatin Mts.)	130	5,590	1.9	1.8
		147	3,971	2.2	2.2	Homestake Tunnel, Mont. (Via Butte)	6,356	2.2	2.2		97	5,590	1.9	1.8
C. M. St. P. & P.	St. Paul Pass (Bitter Root Mts.)	244	4,170	1.7	1.7	Pipestone Tunnel, Mont.	6,347	1.7	2.0	Loweth, Mont. (Belt Mts.)	124	5,802	1.0	2.0
Great Northern	None	...	...	...	...	Marias Pass, Mont.	5,213	1.8	1.0	None	...	...	...	...
Canadian Pacific	None	...	...	...	...	Crowsnest Pass, Canada	4,459	1.4	2.0	None	...	...	...	...
	None	...	...	...	...	Kicking Horse Pass, Canada	5,338	2.2	1.8	None	...	...	...	...
Canadian National	None	...	...	...	...	Yellowhead Pass, Canada	3,717	0.7	0.4	None	...	...	...	...

Lemhi Pass, on the boundary between Montana and Idaho, 100 miles southwest of Butte, has a history reminiscent of South Pass in that it was the first to be known in the region, but never occupied by a railway, the Northern Pacific finding Mullan and Homestake passes much more advantageous. Lemhi, of course, was the pass used by Lewis and Clark on their way to the Pacific in 1805. On their returning trip in 1806 the party divided; Clark explored the Yellowstone River while Lewis went north to find the headwaters of the Marias. By some quirk, the name Lewis and Clark Pass has been given to the pass north of Helena, which Lewis alone used and Clark never saw, while the pass Clark used and Lewis never saw is called Gibbon. Lemhi, which they both used and which by all the rules should be called Lewis and Clark Pass, has never been so designated.

The Gilmore and Pittsburgh Railroad, which may be classed as a frustrated transcontinental line, built near Lemhi Pass but used Bannock Pass instead, at El. 7,574, a few miles to the south. An improved highway does go through Lemhi, while South Pass now is almost inaccessible. Incidentally, South Pass was so named because it lies far to the south of Lemhi and the others which Lewis and Clark discovered. El Paso del Norte, the most southerly of all, received its name because it leads to the north from Mexico.

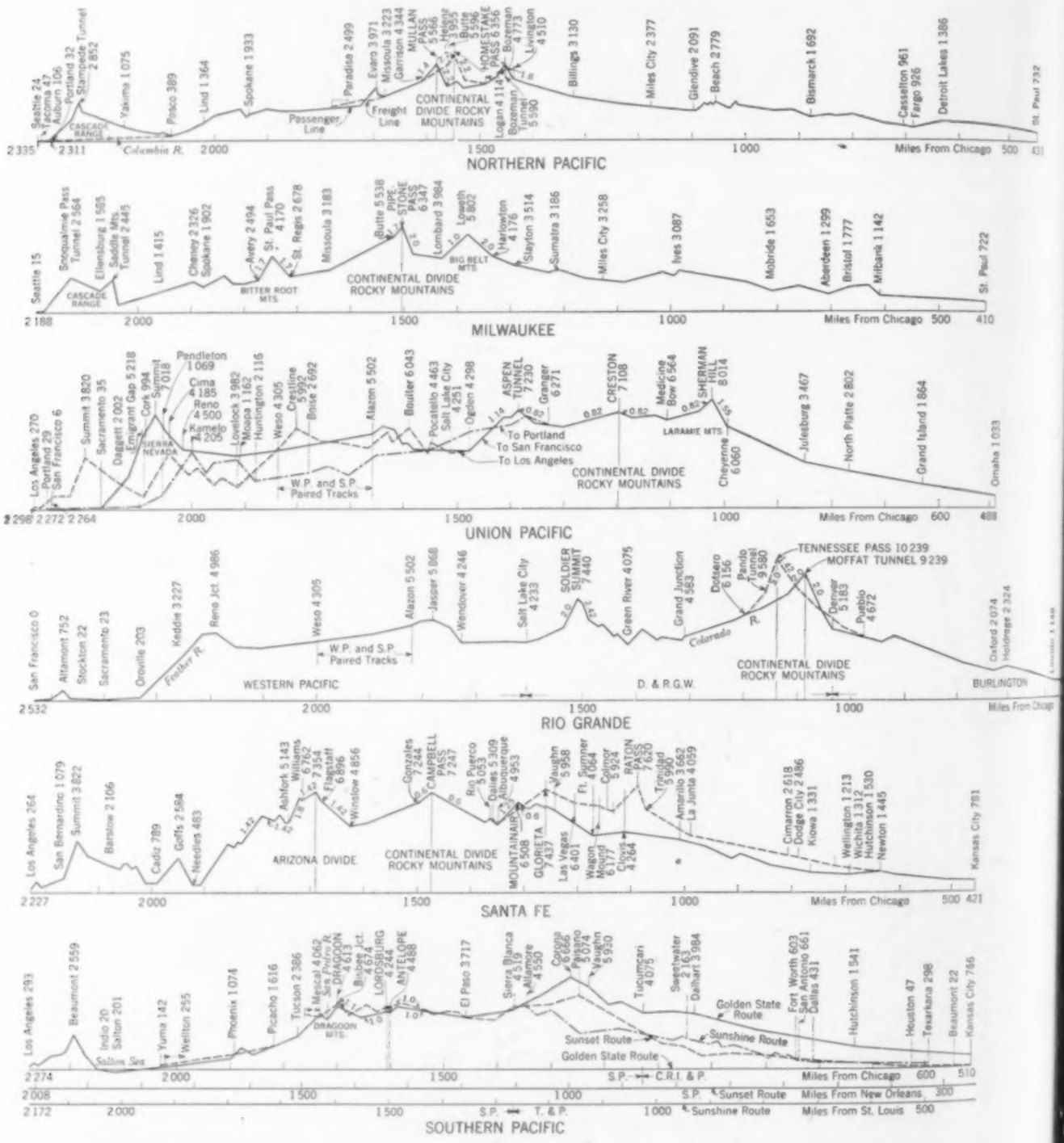

FIG. 2. PROFILES OF THE SIX TRANSCONTINENTAL LINES DISCUSSED IN THIS ARTICLE

The Hydraulics of Surface Runoff

A Test of Some Common Assumptions of Applied Hydrology

By LeRoy K. Sherman, M. Am. Soc. C.E.
Consulting Civil Engineer, Chicago, Ill.

IN two pages, Mr. Sherman here gives the gist of a much longer paper of the same title. The complete manuscript is on file in the Engineering Societies Library, 29 West 39th Street, New York.

THE purpose of this paper is to test the correctness and limitations of some of the assumptions or hypotheses now used in applied hydrology.

Under a given set of conditions, the quantitative phenomena of rainfall, loss, pondage, and runoff may be reduced to a purely hydraulic problem—one that can be solved by well-known and accepted hydraulic procedures. Any assumptions in hydrology, conflicting with such hydraulic analysis, must be erroneous. Agreement of results is an evidence of correctness. The hydrologic hypotheses to be tested include the unit graph, the relation of the hydrographs of surface runoff and channel outflow, the effect of natural detention reservoirs, channel storage, infiltration capacity, or rates of loss.

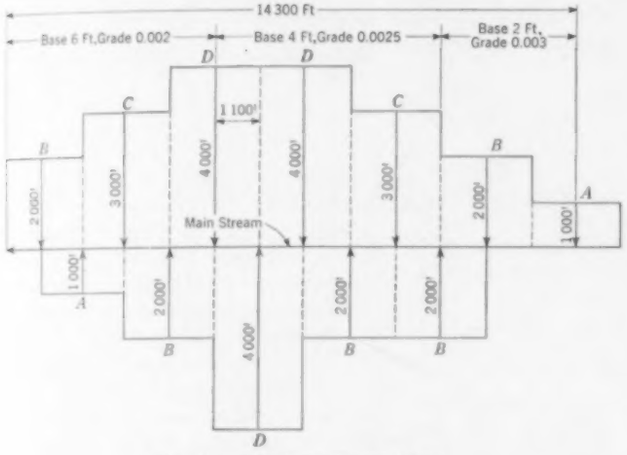

FIG. 1. THE DRAINAGE AREA

Base Widths and Grades Shown at Top Are for Main Stream
All Sub-Areas Drain, at Right Angles, Into the Laterals

We will apply the hydraulic test, with a given set of conditions, to the area shown in Fig. 1. The main stream is 14,300 ft long, with slopes and bottom widths as shown at the top of the figure. Lateral streams drain the designated sub-areas of sizes *A*, *B*, *C*, and *D*.

The test will consist in the derivation and comparison of three pairs of hydrographs of runoff: (1) the overland flow into a lateral channel; (2) outflow from the laterals into the main stream; and (3) the discharge from the main stream at the end of the basin. Each pair of runoff hydrographs will be caused by: *a*, a light rain, and *b*, a heavy rain. The duration of the rain in all six cases is the same. We will lay aside our hydrology. Rain is water applied to the surface throughout the basin.

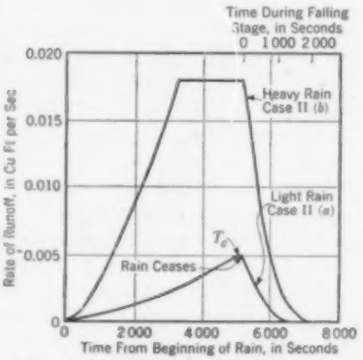

FIG. 2. OVERLAND FLOW FROM A 1-FT STRIP 1,000 FT LONG

It will be impossible to present the hydraulic computations, or even to explain the methods in detail, in this article. For such material the reader is referred to the writer's unpublished manuscript of the same title, on file in the Engineering Societies Library. Suffice it to say here that the hydrographs were all computed by routing small finite increments of flow through given channel distances or reaches—100-ft reaches for overland flow, 500-ft reaches for laterals, and, on the main channel, the distances between lateral streams. The derived volumes in every case have been carefully checked by the storage equation: Inflow = Outflow (runoff and infiltration) ± Storage. In the process of routing, time of transit is in accordance with Seddon's wave velocity, *m*, which is equal to the increment of discharge divided by the corresponding increment of cross-section area. (See "River Hydraulics," by James A. Seddon, M. Am. Soc. C.E., TRANSACTIONS, Vol. 43 (1900), p. 179). This applies to overland flow as well as channel flow. (The use of average stream velocity, *v*, in place of *m*, will not check with the storage equation, and the derived hydrographs will not be correct. The difference is shown in Fig. 5.) The derivation of the falling stages of overland flow was made by computing charts of water surface profiles of the stream, first at maximum stage and then at later time intervals.

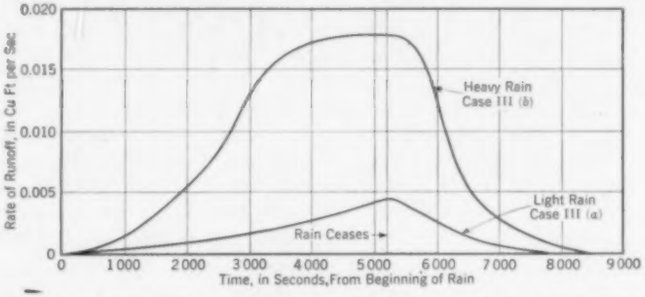

FIG. 3. OVERLAND FLOW FROM A 1-FT STRIP 1,100 FT LONG, WITH DETENTION STORAGE

DISCUSSION OF HYDROGRAPHS

So much for methods. Let us now apply them to the problem already outlined.

Overland Flow. Consider a strip of ground, 1 ft wide, sloping 1,000 ft toward a lateral channel. The rain falls at a uniform rate of 0.864 in. per hr for 1.44 hours (5,200 sec). There is an infiltration capacity *f* of 0.65 in. per hr. The slope and surface of the sub-areas are such that velocity of the overland flow has the relation to mean depth of $v = 1.25\sqrt{d}$. Figure 2, case II(*a*), shows the computed hydrograph of surface runoff at the lower end

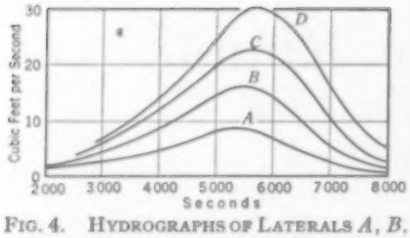

FIG. 4. HYDROGRAPHS OF LATERALS *A*, *B*, *C*, AND *D*, FOR LIGHT RAIN (CASE IV*a*)

of the strip 1,000 ft long and 1 ft wide. Case II(*b*) shows the similar hydrograph for a greater rain intensity, 1.728 in. per hr, and an infiltration capacity of $f = 0.93$ in. per hr.

Reservoir Detention. The end of each 1,100-ft width, along the lateral channel banks, is obstructed by willows, brush, etc. This forms a 100-ft detention reservoir similar to those occurring on most natural basins. The rate of discharge from this detention reservoir into the lateral channel varies with the depth so that $q = 0.33d^{3/2}$.

The inflow into this reservoir is the hydrograph of surface runoff from the 1,000 by 1-ft strip, just derived and shown in Fig. 2. This inflow was routed through the 100 ft of detention reservoir, utilizing the method given by Prof. H. K. Barrows in his article, "Reservoir Storage Above Spillway Level" (CIVIL ENGINEERING for April 1933). Figure 3 shows the derived outflow hydrographs from the 1,100-ft strips. Comparing these with Fig. 2, we note the typical rounding of corners due to detention storage. Also to be observed is the difference in the time of concentration under light and heavy rain intensity, due to higher velocity at high stages.

Runoff in Lateral Channels. In every lineal foot of channel length, the laterals draining the sub-areas *A*, *B*, *C*, and *D* in Fig. 1 receive twice the overland rate of flow given by the hydrographs in Fig. 3. These laterals have side slopes of 1 on 2 to 1 on 3; bottom widths of 2 to 6 ft; longitudinal slopes of 0.002 to 0.003; and roughnesses corresponding to a Manning's n of 0.030. Figure 4 shows the derived hydrographs of discharge from the four sub-area types for the light rain, and Fig. 5 gives the lateral hydrographs for the heavy rain.

Main Channel Hydrographs. The two outflow hydrographs for the entire basin are shown in heavy lines in Fig. 6. Infiltration loss takes place only during the period of surface runoff. The runoff volume from a strip 1,100 ft by 1 ft is shown by the hydrographs of Fig. 3. The runoff from the light rain III(*a*) on a 1,100-ft strip is 12.76 cu ft. The basin contains 60,000 such strips, thus giving 765,000 cu ft as the total runoff shown by hydrograph *a* in Fig. 6. The corresponding volumes for the heavier rain *b* (also falling in 5,200 sec) are 5.55 times those of *a*.

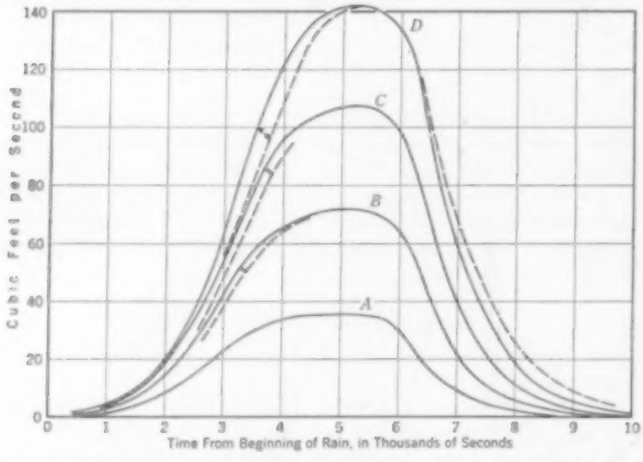

FIG. 5. HYDROGRAPHS OF LATERALS *A*, *B*, *C*, AND *D*, FOR HEAVY RAIN (CASE IV*b*)

Wave Velocity, m, Was Used to Determine Time of Transit in the Routing Process. For Purposes of Comparison, the Dashed Lines Show Portions of the Incorrect Hydrographs Resulting from the Use of v in Place of m

OBSERVATIONS AND CONCLUSIONS

1. *Unit Hydrograph.* Hydrographs II(*a*) and II(*b*), Fig. 2, and III(*a*) and III(*b*), Fig. 3, are not unit graphs because their unit time, 5,200 sec, is greater than the concentration periods for the 1,100-ft strips they represent. However, the hydrographs for the whole basin (Fig. 6) may be considered as unit hydrographs for 5,200 sec with their respective volume of runoff. By the unit hydrograph hypothesis, the ordinates of two unit-time hydrographs are proportional to their respective volumes.

The dotted hydrograph in Fig. 6 shows the ordinates of *a* expanded 5.55 times for comparison with *b*. Note the close agreement in peak rates, although the expanded peak *a* is slightly higher than the actual peak *b*. The actual hydrograph *b* appears earlier than its unit hydrograph derivation. The base of the larger hydrograph *b* is larger than the base of *a*.

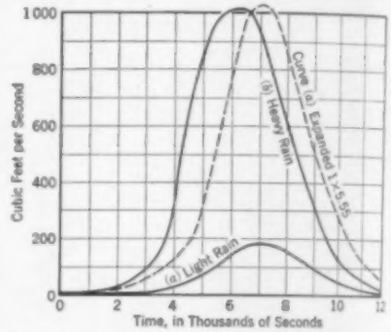

FIG. 6. MAIN-CHANNEL HYDROGRAPHS FOR BOTH LIGHT RAIN AND HEAVY RAIN

Solid Lines Show Actual (That Is, Computed) Hydrographs. Dashed Line Is the Unit Hydrograph Derivation of *b*

Our example purposely utilized a wide difference between the net rain intensities *a* and *b* and also high infiltration capacities in order to bring out the approximations involved in the hydrologic assumptions. Ordinarily there will be closer agreement.

2. *Infiltration Versus Loss Rates.* In our example, the figures $f = 0.65$ and $f = 0.93$ are infiltration capacities—that is, the actual rates per hour at which effective rain penetrated the soil. In hydrologic practice, these figures are approximated by the so-called rain excess method. The volume of observed runoff is matched by the volume of rain excess, computed by assumed values of f. The value of f that makes the rain excess equal to the runoff is accepted as the true loss rate. Our computations furnish tests of this infiltration hypothesis.

For case *a*, the volume of runoff we found was 765,600 cu ft, or a 0.1392-in. depth on the basin of 2.37 sq miles. The duration of effective rain was 1.444 hours. The derived average loss rate by the approximate method is 0.77 in. instead of the true infiltration capacity 0.65 in. Similarly, for rain *b*, we find the loss rate of 1.2 in. instead of the true infiltration capacity of 0.93 in. As the duration of the rain increases, and where the soil is less pervious, these differences in f become less. The discrepancy is due to the fact that loss, by infiltration, continues during the recession of overland flow after effective rainfall has ceased.

The foregoing analysis confirms the principle of the unit hydrograph as to proportionality of ordinates, provided the selected time-unit is less than the minimum concentration period. The analysis indicates that average loss-rates, except for large storms of relatively long duration, cannot be used as figures for infiltration capacity.

Robert E. Lee—Civil Engineer

A Century Ago His Regulating Works Preserved St. Louis as a River Port

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SO great is the glamor of proficiency in war that similar success in peaceful pursuits, even by the same individual, is often overlooked—or forgotten. Who remembers, for instance, that Robert E. Lee, before he was wounded in the Mexican War and long before he gained fame as the military genius of the Civil War, was a civil engineer of note? As Mr. Brooks explains, Lee's well-conceived and carefully executed engineering plans rescued St. Louis from impending isolation as a river port. This interesting segment of history is buttressed by several little-known pieces of documentary evidence, both textural and graphic, to show that Lee was indeed a great civil engineer. Appropriately enough, steps are now being taken by the Society's St. Louis Section to perpetuate recognition of his contribution to the commercial success of that metropolis.

JUST about a hundred years ago, Robert E. Lee, a civil engineer, saved St. Louis from becoming an inland city—a story interesting in its own right and especially so in the light of modern developments. Son of "Light Horse Harry" who was a Revolutionary War colleague of General George Washington, Lee is known widely for his military and educational achievements. But it was his civil engineering ability for design and construction which not only harnessed the Mississippi River at St. Louis but also earned for him a well-deserved promotion. This advancement put him in charge of repairs to the defenses at New York Harbor and later made him chief engineer of the Army under General Wool in the war with Mexico. After a tour of duty as superintendent of the U.S. Military Academy from 1852 to 1855, he again returned to St. Louis in 1855, this time as commander at Jefferson Barracks adjacent to the city.

St. Louis was founded in 1764. It grew as a western frontier city, its population increasing rapidly through river transportation. In 1834, there were 230 steamboats, with a tonnage of 39,000, which made half a dozen trips a year between St. Louis and New Orleans. Ten years later the number had increased to 686 and the tonnage to 144,000. At that period—a century ago—a population of more than 30,000 gave St. Louis an enviable position among the cities along the Mississippi.

During the early 1830's the river as it flowed past the city had started to meander to the east. Sand bars had formed islands. One south of the Mill Creek Valley was known as Duncan's Island and one immediately to the north of the city as it then existed had the picturesque name of Bloody Island—it was rumored that many duels were fought there.

The river was moving its main channel eastward away from the city to a position between Bloody Island and the Illinois shore. This gradual shifting of the channel was about to ruin St. Louis as a river port. So the city employed one John Goodfellow to haul the sand away from the bars with ox teams; and the Mayor was authorized to borrow on the credit of the city $12,000 in payment. But this attempt was a failure, as more sand was continually deposited and steamboats still went aground when attempting to land even as far north as Olive Street.

After St. Louis was made a port of entry, in 1836, Congress appropriated $15,000 to direct the current of the river back to its old channel. The Mayor, however, on October 6, 1836, declined the offer except under the authority and supervision of the Engineer Corps of the U.S. Army.

Thus it was that Robert E. Lee, a lieutenant at that time and shortly afterwards a captain, was placed in charge of the work. Arriving in August 1837, he made a preliminary survey and a report the following December to General Gratiot, Chief Engineer of the War Department. Accompanying the report was a map of the area studied, drawn by Lee himself and reproduced herewith (Fig. 1). In Lee's own words, the situation was as follows:

"The appropriation for the improvement of this harbor has for its object the removal of a large sand bar, occupying below the city the former position of the main channel of the Mississippi; which, gradually augmenting for

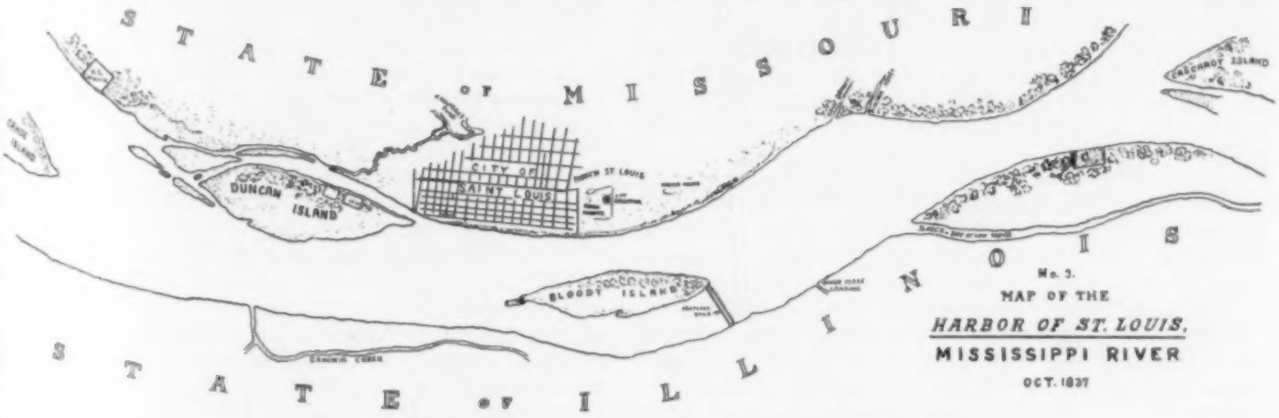

FIG. 1. LEE'S MAP OF THE MISSISSIPPI RIVER AT ST. LOUIS
With His Assistant, Henry Kayser, He Prepared Plans and Estimates, Working Nights in His Office, the Cabin of a River Steamboat, Moored near the Works

many years, has now become an island of more than two hundred acres in extent, covered with a growth of young cottonwood, and reaching from the lower part of St. Louis, which it shuts out from the river, to two miles below. The extensive shoals formed around its base extend on the east to the middle of the river, and, connected with the main land on the west, afford, at low water, a dry communication between. A flat bar projects from the upper end to the foot of Bloody Island, opposite the town, which, at low stage of the river, presents an obstacle to the approach of the city, and gives reason to apprehend that, at some future day, this passage may be closed. This is rendered more probable by the course of the river above, and can be better explained by reference to the accompanying map [Fig. 1]. The united waters of the Missouri and Mississippi, for some miles below their junction, sweep with great velocity along the Illinois shore, when they are deflected to the Missouri side. The main body, passing west of Cascarot Island, joins with the lesser portion at its foot, and the whole is compressed between the narrow gorge. Spreading out in the wide area below, the main current still keeps to the Missouri shore; while a large part of the river, directed to the Illinois side, is fast wearing away its bank, and cutting out a large channel."

METHODS PROPOSED TO CORRECT CHANNEL ALINEMENT

"It is, therefore, evident that it is only necessary to concentrate the current wherever the channel requires to be deepened; that the branch of the river which passes between the city and Bloody Island has a velocity sufficient to excavate the bed to the depth of 39 feet below low-water level; that this depth continues as far as the section continues; and would, in all probability, extend, if the section were lengthened. . . .

"But in order to arrest the wearing away of the eastern bank of the river, and to protect the Illinois shore, it will be necessary to divert from it the force of the current. This may be done by running a dike from above the small slough on that side, parallel to the western shore, sufficiently far to throw the water west of Bloody Island.

"The distance from where the dike would have to be commenced, to the head of Bloody Island, is 1.5 mile, and the length of the dike would require to be equal to half this distance, or $^3/_4$ of a mile, and might be obliged to be extended the whole way. The same effect would be produced by throwing a dam directly across from the head of Bloody Island to the Illinois shore; the dead water created by which would extend as high as the point above the slough, and, by its resistance, throw the great body of the river into the Missouri channel. This will also bring a greater volume of water to bear upon the bar and head of Duncan's Island; and by constructing a dike from the foot of Bloody Island, parallel to the shore in front of the city, and of sufficient length, it will receive the proper direction.

"The length of the dam will require to be 594 yards, and its height five feet above low-water level; its width on top is ten feet, having its exterior slopes equal and three of horizontal to one of vertical height. A row of piles, five feet from center to center, are driven firmly into the bed of the river, at the intersection of the slopes with the plane of low water. Brush, of proper length, to extend well toward the toe of the slopes, with their butts and branches so interwoven with the piles as to be held firmly in place and form a complete matting, is laid at right angles with the direction of the dike, and sunk to the bed of the river with large stones. This is carried up as high as low-water level; the interior filled in with small stones, sand, facines, etc., and the slopes and crest above this plane revetted with stones placed on their edge, and well bound together, so as to form a revetment of from a foot and a half to two feet thick. The slopes below the plane of low water are secured by throwing stones promiscuously over, and distributing them as equally as possible.

"The length of the dike is 1,000 yards; it will probably require not to be less than this, but must be determined by its effect. Its height above low water will be five feet and the plan and mode of construction are the same as were described for the dam. In addition to these works, the western shore of Bloody Island will have to be protected from its head to the center, so as to secure it against the action of the current. The erection of these works will be attended with great difficulty.

LOOKING ACROSS THE RIVER TO ST. LOUIS IN LEE'S DAY

From an Engraving by J. C. Wild, Published in 1840 by the *Missouri Republican*. What Is Probably an Original Indian Mound Appears on the Right Horizon. Just Showing at the Far Left Is What May Have Been Bloody Island. Compare with Lee's Map

"The importance of St. Louis in a commercial point of view, the vast country of which it is the market, and the interest it has at stake in the improvements under consideration, are so well known to you, that I need not urge upon the department the necessity of affording all the relief that the case will admit of . . . .

"The portion of the river embraced in the survey is eight miles in extent. The triangulation of its shore gives their relative position with much accuracy; and from the soundings on the cross section, its bed, as it then stood, has been carefully laid down.

"The necessary preparations for commencing the work early next year will be made this winter."

COSTS OF WORK ESTIMATED

Lee estimated that to put the Mississippi back into its old channel would require (1) a dam at the head of Bloody Island, to cost about $64,000; (2) a dike running down the west side of Bloody Island, about $81,000; and (3) the necessary protection of the head of Bloody Island, about $14,000. The total estimated cost was about $160,000.

With $50,000 appropriated by Congress (the original $15,000 plus an additional appropriation of $35,000) and $15,000 appropriated on October 30, 1837, by the city, Captain Lee succeeded in returning the river to its original channel near the Missouri shore. The sand bars were washed out and the harbor was deepened so that there was $13^1/_2$ ft of water over the bar. This was the initial step in carrying out his program of keeping the river tamed.

It is recorded that within a year, that is, by July 1838, the young civil engineer had pushed Duncan's Island

considerably downstream. With the current back in its old channel the river was saved to St. Louis, which because of this has continued to be the river metropolis of the Mississippi Valley. His theory and designed system of dikes and revetment control had accomplished the result. He had mastered the river problem at this locality.

In planning this work Captain Lee was given a free hand. He studied the system of dikes maintained in Holland and also used some ideas he had seen put into practice on the Hudson River. Regarding the peculiarities of the bed of the Mississippi his observations are of interest today:

"The whole bed of the river is composed of the alluvial matter brought down by the Missouri, consisting of a light loam, mixed with the finest sand, which melts and yields to every pressure of the current. Its depth must be at least 40 ft below low-water level, and has so little stability as to be changed by every flood. Besides the unfavorable foundation, the great velocity of the Mississippi, its violence during the spring freshets, and the short season for operations, present impediments so great, that, in addition to the uncertainty always connected with hydraulic architecture, the results cannot be predicted. . . .

"Wherever the bed of the river is sufficiently contracted a regular and deep channel is formed by the current and this is always interrupted when the water is spread over too large a surface."

ROBERT E. LEE IN DRESS UNIFORM AS LIEUTENANT OF ENGINEERS IN 1831

This Painting Is Accredited to Benjamin West, Jr. For Years It Was in Possession of Washington and Lee University, But More Lately Has Been in the Lee Family

LEE DISCUSSES COMPLETION OF WORK HE BEGAN

The work done by Robert E. Lee in the St. Louis harbor was of a temporary nature and needed additional extensive supplementary work. In a letter to his associate, Kayser, written in December 1839 or January 1840—just one hundred years ago—Lee commented on the work accomplished and that remaining to be done, as follows:

"The pier from the foot of Bloody Island confines the water to the Missouri shore, and directs the current against the head of Duncan's Island. A large portion of the head and eastern face of this Island has been washed away during the past year. The deep water now extends close to it, and admits the largest boats to the lower part of the city. The depth of the river on the Illinois side is diminishing proportionally, and the shoal formed under the influence of the pier from the foot of Bloody Island is extending itself down the river, and assisting the operation of the pier itself.

"Both piers, however, require to be finished. The upper ought to be strengthened and extended down the river, and the lower completed. The greater body of water that now passes west of Bloody Island is thrown, by some cause, from the rocky point above the city directly over towards Bloody Island, as far back as the line of the pier. The foundation of the pier, where it crosses this shoal, has consequently been undermined; but the settling of the stone to the bottom of the river has apparently arrested, for the present, the further action of the current. The shoal beyond the line of the pier has grown to an island, and is covered with a growth of cottonwood trees. Its whole face now requires to be revetted with stone, to prevent its further wear, and the probability of the river breaking through and resuming its former channel. In this event, the lower part of the pier, which was laid in deep water, and remains permanent, would be separated from the upper part, and might connect itself with Duncan's Island, and form a more permanent obstruction than has been removed. At present the harbor is in a good condition, and only requires to be kept so. The only unfavorable circumstance that I can discover is the appearance of a small shoal near the foot of the lower pier, and about midway between it and the city. I believe it, however, to be an accumulation of the sand washed from the shoal above, and that it is traveling down the river. I think it impossible for it to remain there, under the present action of the current; and so far as I can judge, it is diminishing."

Work as District Engineer in St. Louis continued to occupy Lee's time. Meanwhile, in August 1838, he had been promoted to his captaincy. The success of all these efforts led to his transfer in 1840 to a more important task, that of construction and repair of defenses to New York harbor. After leaving St. Louis, he recommended and saw to it that Henry S. Kayser, whom he had trained in the work, took charge of it and completed it. Mr. Kayser served as city engineer of St. Louis from the fall of 1839 until 1850, with the exception of the year 1846. The last part of the work of protection, as designed by Lee, was completed by the City of St. Louis in 1856. Bloody Island had become a part of East St. Louis, Ill., and Duncan's Island had been washed away entirely.

Hon. John F. Darby, mayor of St. Louis when the work was begun, summed up these accomplishments thus: "By his rich gift of genius and scientific knowledge Lieut. Lee brought the father of waters under control."

Even in St. Louis relatively little would be known of Lee's civil engineering achievements were it not for the painstaking research and investigation of Miss Stella M. Drumm of the Missouri Historical Society, who has written considerably about Robert E. Lee and has collected his letters to Henry Kayser, then city engineer of St. Louis, during the period 1838 to 1846. From her writings I have abstracted the preceding factural details, which are fully authenticated by contemporary documents.

Recently the St. Louis Section of the Society has taken renewed interest in these historic records. At its annual meeting in December 1939, it took steps looking toward the perpetuation of Lee's civil engineering achievements by an appropriate memorial. It is proposed that this be situated on the site of the Jefferson Memorial National Park now being constructed at St. Louis on the banks of the river which this great civil engineer mastered one hundred years ago.

ENGINEERS' NOTEBOOK

Ingenious Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Analyzing Non-Homogeneous Sections Subjected to Bending and Direct Stress

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STRESSES in non-homogeneous sections may be computed by applying the general flexure formula, with successive corrections, to the properties of the section. The method was suggested by Hardy Cross, M. Am. Soc. C.E., in "The Column Analogy" (University of Illinois Bulletin No. 215, issued October 14, 1930, pp. 18–22), but does not seem to have been given much notice in recent reference books on the mechanics of reinforced concrete.

The types of problem to which the method may be applied include: (1) beams or columns of reinforced concrete subjected to direct stress and symmetrical or unsymmetrical bending; (2) determinations of pressure on foundations when the resultant of the vertical loads does not fall on an axis of symmetry, and the line of zero pressure (neutral axis) lies in the footing area. Problems may also be solved in this manner when a portion of the foundation is composed of one material, such as sand, and the remainder of a material of different compressive modulus, such as clay.

The following nomenclature will be used:

x, y = rectangular coordinates of any point
x_o, y_o = coordinates of the centroid
x_o, y_o = coordinates referred to axes passing through the centroid of the section and parallel to the original axes
f = normal stress at any point x_o, y_o
A = transformed area of section
a = sub-area
I_x = moment of inertia about y-axis
I_y = moment of inertia about x-axis
$I_{xy} = \int xydA$ = product of inertia about axes x and y
i = moment of inertia of a sub-area
M_x = moment of external forces about y-axis $= Px$
M_y = moment of external forces about x-axis $= Py$
P = normal component of external forces

The general flexure equation, for axes through the centroid, is

$$f = \frac{P}{A} + \left[\frac{M_{x_o} - M_{y_o}\frac{I_{x_oy_o}}{I_{y_o}}}{I_{x_o} - \frac{I_{x_oy_o}^2}{I_{y_o}}}\right] x_o + \left[\frac{M_{y_o} - M_{x_o}\frac{I_{x_oy_o}}{I_{x_o}}}{I_{y_o} - \frac{I_{x_oy_o}^2}{I_{x_o}}}\right] y_o \quad \ldots(1)$$

This is the equation of a plane of the type $B + Cx + Dy = Z$. It will be seen that if $f = 0$, Eq. 1 becomes the equation of the neutral axis—that is, the trace of the plane on the x-y plane. In tabulating the computations it will be convenient to make the following substitutions: C_n (that is, the numerator of the coefficient of x) $= M_{x_o} - M_{y_o}\frac{I_{x_oy_o}}{I_{y_o}}$; $D_n = M_{y_o} - M_{x_o}\frac{I_{x_oy_o}}{I_{x_o}}$; $C_d = I_{x_o} - \frac{I_{x_oy_o}^2}{I_{y_o}}$; and $D_d = I_{y_o} - \frac{I_{x_oy_o}^2}{I_{y_o}}$, so that Eq. 1 becomes

$$f = \left(\frac{P}{A} + \frac{C_n}{C_d}\right) x_o + \left(\frac{D_n}{D_d}\right) y_o \quad \ldots\ldots(2)$$

and the equation of the neutral axis becomes

$$\left(\frac{P}{A} + \frac{C_n}{C_d}\right)\left(x_o + \frac{D_n}{D_d}\right) y_o = 0 \quad \ldots(3)$$

The product of inertia, I_{xy}, about the centroidal axes of a section may be found in general either by integration or by graphics. For a right triangle, $I_{xy} = \frac{b^2h^2}{72}$ about its centroidal axes. The sign will be minus if the hypotenuse slopes downward to the right, and plus if it slopes downward to the left. For a rectangle the centroidal $I_{xy} = 0$.

A reinforced concrete section may be considered as consisting of three elements: (1) a concrete area in tension, $A_t \times 0$; (2) a concrete area in compression, $A_c \times 1$; and (3) area of steel $A_s \times 12$ (assuming that $n = 12$). The problem is to find the neutral axis of the section. The method used is to as-

TABLE I. FIRST COMPUTATION

	a	x	y	ax	ay	$ax^2 + i_x$	$ay^2 + i_y$	$axy + i_{xy}$	M_x	M_y
Steel	33	..	..	198	426	1,582	8,004	2,556	110	−280
Concrete triangle	36	8	11	288	396	2,304	4,356	3,168	....	....
						288	72	72	....	....
Concrete rectangle	108	6	4.5	648	486	3,890	2,190	2,920	....	....
						1,296	729	0	....	....
Totals	177	...	....	1,134	1,308	9,360	15,351	8,716	....	....
Coordinates of centroid	...	+6.4	+7.39	.....	.....	....	....	....	....	....
To correct to centroid						7,240	9,660	8,410	+64	+73.9
						2,120	6,691	306	+46	−353.9
Corrections for C_d, D_d, C_n, and D_n						14	44	....	−16.2	+6.6
Final results						2,134	6,647	....	+62.2	−360.5

Equation of neutral axis: $\frac{10{,}000}{177} + \frac{62{,}200}{2{,}134}x_o - \frac{360{,}500}{6{,}647}y_o = 0$

y-intercept, left side of section, = 5; right side of section, = 11.47

$f_s = \frac{360{,}500}{6{,}647} \times 17 \times 12 = 11{,}100$

$f_c = \frac{360{,}500}{6{,}647} \times 11.5 = 635$

sume a neutral axis, compute the properties of the section, apply the general flexure formula, and solve for the neutral axis; then repeat the process, revising the concrete area to conform with the position of the neutral axis as just computed. (In the revision, the properties of the steel area need not be recomputed.) Two computations are usually sufficient, if the first assumed location of the neutral axis was reasonably close to the final position.

This method may also be employed in problems involving bending and direct stress on symmetrical sections where the bending occurs along one axis of symmetry. In this case, Eq. 1 reduces to $f = \frac{P}{A} + \frac{M_{x_o}}{I_{x_o}} x_o$, or $= \frac{P}{A} + \frac{M_{y_o}}{I_{y_o}} y_o$, and the equation for the neutral axis is $\frac{P}{A} + \frac{M_{y_o}}{I_{y_o}} y_o = 0$. However, only the more complicated case of bending in two directions will be considered here.

For a typical example consider the reinforced concrete section shown in Fig. 1, which we will assume to be loaded with a direct load of 10 kips, applied perpendicular to the plane of the paper at a point 28 in. below the x-axis and 11 in. to the right of the y-axis. Thus $M_y = -280$ kip-in. and $M_x = 110$ kip-in. The neutral axis will first be assumed as defined by the points $x = 0$, $y = 9$, and $x = 12$ in., $y = 15$ in. Since the section is unsymmetrical all its properties must be computed. The computations are first made about the assumed axes, then transferred to the computed centroid, and corrected by use of Eq. 2. Next, substituting in Eq. 3, a location of the neutral axis is computed. All these steps are shown in Table I. The section is then reexamined (Table II) until the movement of the neutral axis is small enough to be neglected.

The properties of the steel area (transformed) are $A = 2.75 \times 12 = 33$; $Ax = 198$; $Ay = 426$; $I_x = 1{,}582$; $I_y = 8{,}004$; and $I_{xy} = 2{,}556$.

The computations are simple but will be explained in detail. The axes are taken for simplicity as coincident with the sides of the section so that the section lies entirely in the first quadrant. The properties of the steel area (transformed) are computed about these axes, and the properties of the area of concrete assumed in compression are similarly computed. From the summation of areas and the summation of the statical moments of the areas, the centroid coordinates are computed $\left(x_c = \frac{\Sigma ax}{\Sigma a};\ y_c = \frac{\Sigma ay}{\Sigma a}\right)$. To correct the properties to the centroid, the following equations are applied: $I_{x_o} = I_x - \Sigma a x_o^2$; $I_{y_o} = I_y - \Sigma a y_o^2$; $I_{x_o y_o} = I_{xy} - \Sigma a x_c y_c$; $M_{x_o} = M_x - P x_c$; $M_{y_o} = M_y - P y_c$. After these corrections are made, the final corrections for C and D are made ($C_d = I_{x_o} - \frac{I_{x_o y_o}^2}{I_{y_o}}$, and so forth). Then the values of the coefficients are substituted in Eq. 3 and the intercepts of the neutral axis with the sides of the section are computed.

The stress then may be found at any point on the section either by $f = \frac{D_n}{D_d} \times$ (vertical distance to neutral axis), or by $f = \frac{C_n}{C_d} \times$ (horizontal distance to neutral axis). The steel stress may be found by multiplying the value of f by 12.

The neutral axis from the first trial will be the limit of the compressive area; then with the properties of the steel area the same as in the first computation, the properties of the revised concrete section are computed (Table II) and the neutral axis equation computed as before. The second or third trial should give results of sufficient accuracy. In the present example, in the second trial the neutral axis moved down 0.45 in. on the left side of the section and 1.31 in. on the right side. It will be seen at once that further computation is unnecessary since area change for the first computation of 25% moved the neutral axis an average of only 0.93 in.

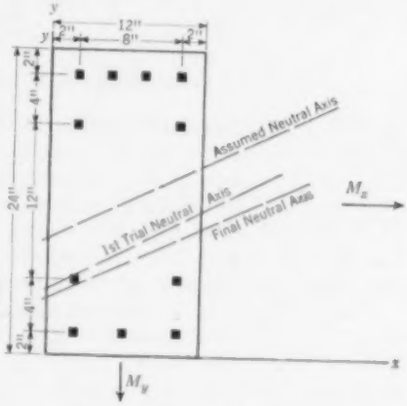

FIG. 1. TYPICAL EXAMPLE
All Bars Are 1/2 In. Square

The above method may be used on sections of any shape with reinforcement placed in any type of pattern. The chief virtue, however, is the simplicity of solution for sections acted on by a direct load and moments in any direction. There are no long complicated equations nor tables necessary, and the computations are simple.

From the foregoing, it is apparent that the equations used for general flexure and for the neutral axis may be applied to footings in which the resultant load acts at any point on a footing of any type of plan resting on material of one kind, such as earth in which the neutral axis lies partially within the footing area. In this case, the area in compression will be given a value of unity and the area which would normally be in tension will be given a value of zero. With an assumed neutral axis, the properties of the assumed compression area are computed. A more exact neutral axis is then deter-

TABLE II. SECOND COMPUTATION

	a	x	y	ax	ay	$ax^2 + i_x$	$ay^2 + i_y$	$axy + i_{xy}$	M_x	M_y
Steel	33	..	..	198	426	1,582	8,004	2,556	110	−280
Concrete triangle	39	+8	+7.17	312	280	2,576	2,010	2,240	....	....
Concrete rectangle	60	+6	+2.5	360	150	312 2,160	76 375	85 900	....	....
						720	125	0	....	....
Totals	132	...	....	870	856	7,350	10,590	5,781	....	....
Coordinates of centroid		6.6	6.5	...	...	....	...	....	....	....
To correct to centroid						5,750	5,560	5,630	+66	+65
						1,600	5,030	131	+44	−345
Corrections for C_d, D_d, C_n, and D_n						3	11	...	−8.9	+3.6
Final results						1,597	5,019	...	+52.9	−348.6

Equation of neutral axis: $\frac{10{,}000}{132} + \frac{52{,}900}{1{,}597} x_o - \frac{348{,}600}{5{,}019} y_o = 0$

y-intercept, left side of section $= -2.05 + 6.5 = 4.45$; right side of section, $= 3.66 + 6.5 = 10.16$

$f_s = \frac{348{,}600}{5{,}019} \times 16.6 \times 12 = 13{,}900$ lb per sq in.

$f_{s'} = \frac{348{,}600}{5{,}019} \times 10.16 = 706$ lb per sq in.

mined, and the properties of the revised compression area are computed for a second trial neutral axis. If the movement is small enough further computation is unnecessary; however, two computations at least will be necessary for accurate results.

The foundation pressure may also be computed when such a foundation is of two materials such as clay and sand. Here comparative values of E must be assigned to the respective material in the compressive area and the neutral axis computed on this basis. Computations are made in the same manner as before, with the exception of the fact that the clay area is to be transformed into an equivalent area to the sand, $A_c E_c E_s$. Where A_c is the portion of compressive area consisting of clay with compressive modulus E_c, and E_s is the compressive modulus of the sand.

Reducing Cross-Section Notes on Highway Construction

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WITH the present-day practice of designing highways for critical speeds of 100 miles per hour and minimum sight distances of 1,000 ft, it is seldom possible for the field engineer to greatly change the designed alinement of a project during construction. However, it is often economical to make grade changes. The following methods will allow the field office, using a calculating machine, to reduce the cross-section notes to a flexible mass diagram within a day after they have been taken.

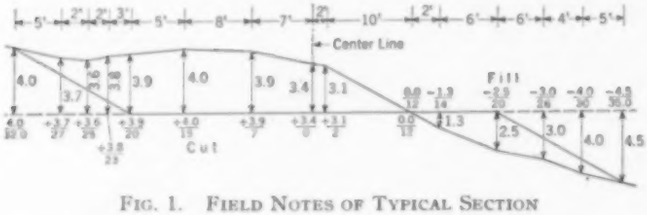


FIG. 1. FIELD NOTES OF TYPICAL SECTION

Field notes for the criss-cross method of cross-sectioning are given as the distance above or below grade, over the distance from the center line (Fig. 1). In computing, the section is broken into a series of triangles, the doubled area of each being found by multiplying the base (vertical distance from grade at that point to the natural ground) by the altitude (horizontal distance between rod readings). Triangles having a common base are computed in pairs, thus:

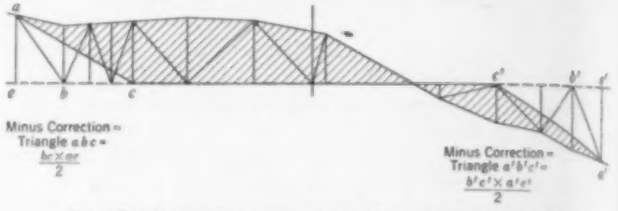


FIG. 2. ILLUSTRATING THE "MINUS CORRECTIONS"

Excavation:

$$(3.7 \times 7) \div (3.6 \times 4) \div (3.8 \times 5) \div (3.9 \times 8) \div (4.0 \times 13) \div (3.9 \times 15) \div (3.4 \times 9) \div (3.1 \times 12) - (4.0 \times 7) = \frac{240.80}{2} = 120.40 \text{ sq ft of excavation area}$$

Embankment:

$$(1.3 \times 8) \div (2.5 \times 12) \div (3.0 \times 10) \div (4.0 \times 9) - (4.5 \times 10) = \frac{61.40}{2} = 30.70 \text{ sq ft of}$$

embankment area. The advantage of figuring triangle areas as base times altitude and later dividing the sum of these areas by two can readily be seen.

The sum of the area of all triangles would be the end area of the section, provided that no rod readings were taken between the shoulder and the slope stake. When such readings are taken, the computations will give the end area of the section plus the oblique triangles *abc* and *a'b'c'* (Fig. 2). These triangular areas are the "minus corrections" and are subtracted.

This cross-section method will give correct results no matter what crown and ditch are used.

Figure 3 is an example of field notes. The estimated swell or shrink of the excavation is written at the top of the excavating yardage column. After computing the quantities as indicated and totaling each page, the mass ordinates are computed. Instead of the usual 0.0 datum plane and plus or minus ordinates, a balance line of any number larger than the largest fill is

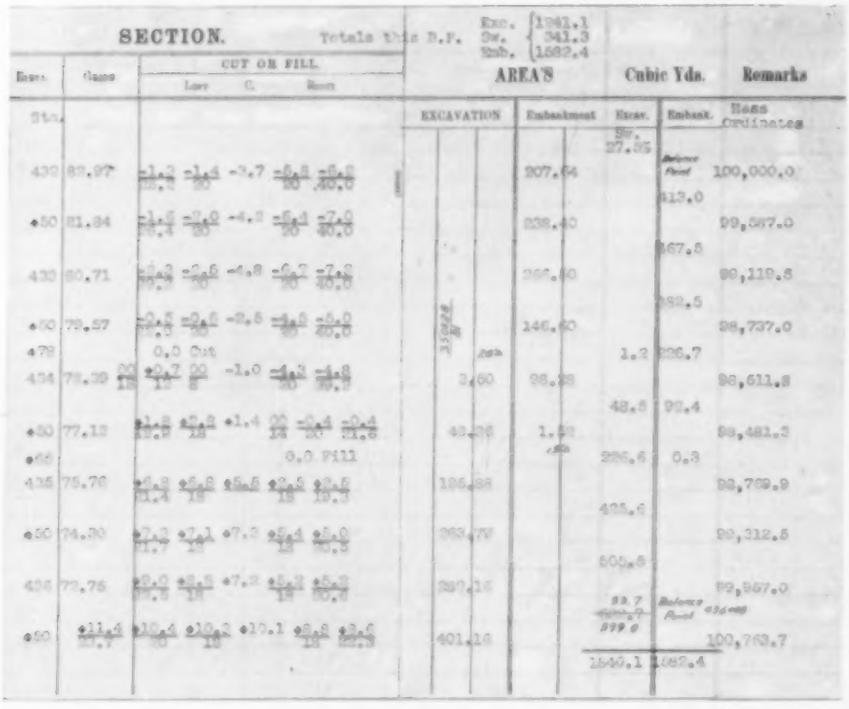


FIG. 3. FIELD NOTES

chosen; 100,000.0 is used in this example. Station 432 ÷ 00 is assumed a balance point.

Each ordinate is the algebraic sum of the quantities between stations. Fill quantities are minus, excavation plus; shrink or swell is applied to the excavation.

Place 100,000.0 in the machine carriage, punch the fill quantity 413.0 on the keyboard and subtract; 99,587.0 is the ordinate at Sta. 432 ÷ 50; 99,119.5 at Sta. 433 ÷ 00, and so forth. The machine carriage is never cleared. Excavation quantities are added and multiplied by the percentage of swell in the same operation. For Sta. 433 ÷ 50, 98,737.0 appears in the machine. The fill quantity 226.7 is subtracted and the excavation quantity 1.2 punched into the keyboard, multiplied by 1.275 (to take account of the swell) giving the ordinate 98,511.8 for Sta. 434 ÷ 00.

On completion of each page a check is made. The above process is reversed and the total fill quantities (page total) are added to the final ordinate and the excavation and swell taken away; the first ordinate on the page should then appear in the machine. An absolute check of the entire balance is shown at the top of the page of sample notes. Exact balance points may be computed as follows (however, it is advisable to plat the mass-diagram first):

From the notes on Fig. 3 it is seen that the balance ordinate 100,000.0 is reached some place between Sta. 436 ÷ 00 and Sta. 436 ÷ 50. This is in a cut and the material is figured to swell 27.5%. The ordinate at Sta. 436 ÷ 00 is 43.0 cu yd of converted excavation short of a balance. The entire converted excavation difference, Sta. 436 ÷ 00 to 436 ÷ 50, is 806.7 cu yd, and the distance between stations is 50 ft. The actual excavation is 632.7 cu yd.

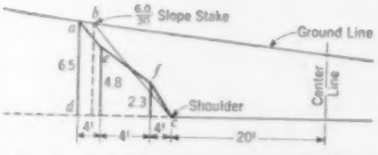
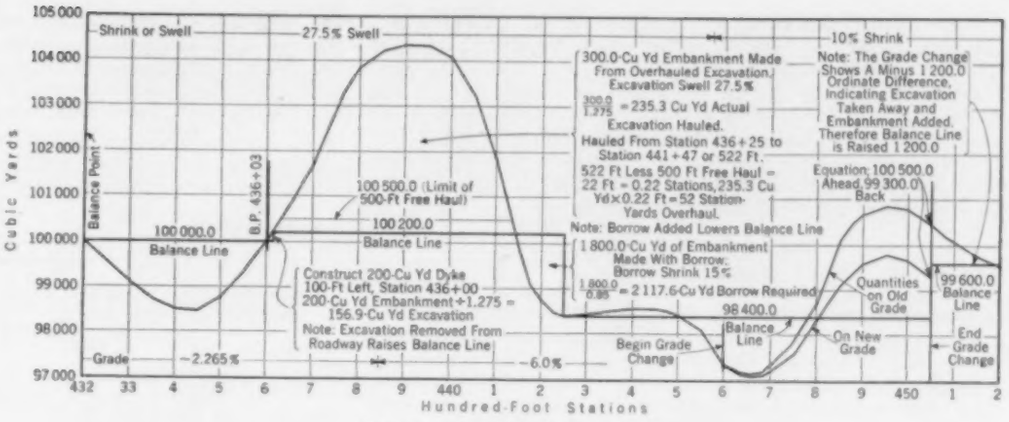


FIG. 5. REMEASURING FOR OVERBREAK

Therefore the balance point is located $\frac{43.0}{806.7} \times 50$ ft = 2.7 ft ahead of Sta. 436 ÷ 00, and $\frac{43.0}{806.7} \times 632.7 = 33.7$ cu yd are needed to effect a balance at that point.


Shrink or Swell
27.5% Swell
10% Shrink
Balance Point
B.P. 436+03
100 000.0 Balance Line
100 500.0 (Limit of 500-Ft Free Haul)
100 200.0 Balance Line
Grade
−2.265%
−6.0%
Construct 200-Cu Yd Dyke 100-Ft Left, Station 436+00
200-Cu Yd Embankment ÷ 1.275 = 156.9-Cu Yd Excavation
Note: Excavation Removed From Roadway Raises Balance Line
300.0-Cu Yd Embankment Made From Overhauled Excavation, Excavation Swell 27.5%
300.0 / 1.275 = 235.3 Cu Yd Actual Excavation Hauled.
Hauled From Station 436+25 to Station 441+47 or 522 Ft.
522 Ft Less 500 Ft Free Haul = 22 Ft = 0.22 Stations, 235.3 Cu Yd × 0.22 Ft = 52 Station-Yards Overhaul.
Note: Borrow Added Lowers Balance Line
1 800.0-Cu Yd of Embankment Made With Borrow; Borrow Shrink 15%
1 800.0 / 0.85 = 2 117.6-Cu Yd Borrow Required
98 400.0 Balance Line
Begin Grade Change
Note: The Grade Change Shows A Minus 1 200.0 Ordinate Difference, Indicating Excavation Taken Away and Embankment Added. Therefore Balance Line is Raised 1 200.0
Equation: 100 500.0 Ahead, 99 300.0 Back
Quantities on Old Grade
On New Grade
99 600.0 Balance Line
End Grade Change
Cubic Yards
Hundred-Foot Stations
FIG. 4. THE MASS DIAGRAM

The ordinates are platted like a profile, as shown in Fig. 4. This diagram extends past the notes given in Fig. 4, to illustrate the handling of imported borrow, overhaul, and so forth. In computing overhaul it is necessary to reconvert the excavation to actual cubic yards as shown. It will be noted that when excavation is added, the balance line is lowered; when embankment is added the balance line is raised.

COMPUTING OVERBREAK AND UNDERBREAK

The following method of remeasuring excavation for overbreak or underbreak is based on the cross-section method previously detailed. Notes of a typical section are shown in Fig. 5, light lines indicating the slope as staked and heavy lines the remeasured slope. Computing the remeasured area *aefcd:*

$\frac{6.5}{32}\ \frac{4.8}{28}\ \frac{2.3}{24}\ \frac{0.0}{20} = (11.3 \times 4) \div (7.1 \times 4) \div (2.3 \times 4) = \frac{82.80}{2} = 41.40$ sq ft. The original slope stake reading is then taken from the original notes, and the area *abcd* computed: $\frac{6.5}{32}\ \frac{6.0}{30}\ \frac{0.0}{20} = (12.5 \times 2) \div (6.0 \times 10) = \frac{85.00}{2} = 42.50$ sq ft. Therefore 1.10 sq ft is the overbreak area. Should the original area be the lesser, the results would show underbreak. "Remeasure" sections may be taken where necessary with no regard for original sections, in which case one shot must be interpolated at the point where the slope stake would have come on the original section.

This method is considerably quicker than the method of platting, templating, and planimetering commonly used, and requires no more interpolating. It automatically deducts any underbreak in a given overbreak end area.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Hammer Efficiencies and Steel Sheet Pile Construction

TO THE EDITOR: Mr. Carriere's paper on the "Steel Sheet Pile Wharf at Rimouski, Quebec," in the December issue, explains a remarkably accurate predetermination of the total driving time on a large pile job based on data derived from a single test pile. In my opinion the accuracy of the prediction is almost a miracle in view of the fact that all the hammer efficiencies and all the effective kinetic energies were incorrectly calculated. The expression for the hammer efficiency, $\frac{W + Pe^2}{W + P}$, is taken directly from Newton's theory of impact. W and P are the weights of the colliding bodies, and e is Newton's coefficient of restitution.

The tabulated data in the left-hand column on page 710 of Mr. Carriere's article show the calculated results for several different hammers. In this table e is taken as 0.5 and P is equal to 2.2 tons. The hammer efficiency for the 10B-2 hammer is given as 0.77, and this is obviously obtained by taking W as 5.0 tons which is the total weight of the hammer. Actually, the ram of a 10B-2 McKiernan-Terry hammer weighs only 1.25 tons, and it is the ram alone and not the entire hammer that strikes the pile. Accordingly, the efficiency of the 10B-2 hammer should be

$$\frac{1.25 + 2.2\,(0.5)^2}{1.25 + 2.2} = 0.52$$

All the other hammer efficiencies are incorrect for similar reasons, and the necessary corrections in the hammer efficiencies will change all the effective kinetic energies. The 5,000-lb double-acting hammer used on the test pile is not fully identified. However, from such data as are given for this hammer, it appears to have been a No. 2 Union which has a ram weighing 950 lb. For the purpose of this discussion, it will be assumed that the ram of the test hammer weighed 1,250 lb or one-quarter of the total weight of the hammer. With this assumption about the test hammer, the efficiencies and effective kinetic energies were recalculated as shown in Table I.

The last three columns of the table refer to the ratios of the effective kinetic energies because the author's entire analysis is based on the assumption that the rate of penetration varied in direct ratio to the effective kinetic energies of the several hammers. Referring to Col. 8, the author's figures indicate that the effective kinetic energy per blow of the 10B-2 hammer driving a single pile was 2.88 times that of the test hammer. Even if the test hammer had a ram weighing 1,250 lb, the effective kinetic energy per blow of the 10B-2 driving a single pile was 3.20 times that of the test hammer as shown in Col. 9. This indicates an error of 11.1% in the author's calculations. If the test hammer was a No. 2 Union with a 950-lb ram, the 3.20 in Col. 9 would be increased to 3.50 and the 11.1% in Col. 10 would become 21.5%. No matter what the ram of the test hammer weighed, it can be seen from the table that there must be important errors in the author's calculations. The actual effective kinetic energies of the McKiernan-Terry hammers do not have the same relationships to one another in Col. 6 that they have in Col. 7.

It is my opinion that the errors in the author's analysis are at least as great as those shown in Col. 10 and it is very probable that they are considerably greater. In any case, the entire analysis should be revised with the weight of the ram used in the hammer efficiency formula instead of the total weight of the hammer.

TABLE I. HAMMER EFFICIENCIES RECOMPUTED

	Weight of Ram	Number of	Hammer Efficiency		Effective Kinetic Energy in Ft-Lb		Ratios of Energies Test Hammer = 1.0		Percentage of Error in Author's
Hammer	Pounds	Piles	Author	Correct	Author	Correct	Author	Correct	Ratios
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Test	1,250*	1	0.69	0.42	4,010	2,440	1.00	1.00	
10B-2	2,500	1	0.77	0.52	11,550	7,800	2.88	3.20	11.1
11B-2	3,625	1	0.81	0.59	17,820	12,980	4.45	5.32	19.5
10B-2	2,500	2	0.65	0.42	9,750	6,300	2.43	2.58	6.2
11B-2	3,625	2	0.70	0.47	15,400	10,340	3.84	4.24	10.4

* Assumed.

A. E. CUMMINGS, M. Am. Soc. C.E.

Chicago, Ill.

TO THE EDITOR: The somewhat positive tone of Mr. Cummings' letter, and his suggestive use of such words as "miracle" and "correct," seem to be out of place in any discussion of pile-driving records and results.

All pile-driving calculations must, admittedly, be based on assumptions; those in the paper were no exception. It is suggested that the results therein presented are nearer to the true values than the corresponding figures given by Mr. Cummings. Variable factors in the equation for efficiency are the weight of the moving part of the hammer and the coefficient of restitution. Rather than increase the latter value above that ordinarily used, and to take into consideration the known greater effectiveness of double-acting hammers as compared with single-acting and drop hammers, the full weight of the hammer was used in the original calculations. Revised calculations, using only the weight of the moving parts of the respective hammers, and a value of 0.70 for e (a value known to be more nearly correct than 0.5 for McKiernan-Terry hammers), give results very close to those originally suggested.

JEAN P. CARRIERE
Assistant Engineer, Department of Public Works of Canada

London, Ontario

California Highway Department Fights Floods

TO THE EDITOR: Mr. Kirkbride's vivid account (in the December issue) of the effect of the deluge of March 2, 1938, on the Southern Pacific Lines within a region around Los Angeles (see his Fig. 1) was of particular interest to the Bridge Department of the California Division of Highways. Some of the principles governing design and maintenance are not the same for highway bridges as for railroads, and the differences may prove of general interest.

About 98% of our estimated structural losses in that flood occurred in the region of Mr. Kirkbride's map, and so discussion may be confined to the same area. A survey of the structural investment and loss as sustained is summarized in Table I.

TABLE I. SUMMARY OF STRUCTURAL INVESTMENT AND LOSS

Item	For the Region	Damaged	Destroyed
Miles of state highway	1,495	110*	4.0
Miles of structure	8.55	4.19	0.84†
Number of bridges	338	73	21†
Average bridge length, in feet	133	303	510†
Value before flood, in $1,000	8,000	4,000	822
Loss in flood, in $1,000	1,068	1,068	822

* Isolated between detour junctions.

† The 21 bridges had a gross length of 10,691 ft, of which 4,448 ft were destroyed.

While rail traffic was completely stopped, less than 8% of the state highway system in the same region became entirely useless for through traffic. The writer has previously pointed out ("Role of Highways in Recent California Floods," CIVIL ENGINEERING, Vol. 8, No. 9) the flexibility and adaptability of the typical highway network existing in this region. After the flood, 92% utility remained after 21% of the structures were damaged and 6% had been destroyed.

This is important. Economic loss from diversion and stoppage of highway traffic was not great. Reconstruction could and did proceed with little expenditure as premium for limited-time contracts. For many of the sites, gaps could be left until carefully designed structures were built under normal procedure; for others, traffic demands during replacement could be satisfied by a ford or by a low-level detour structure after subsidence of floods.

Table I also shows that the longer bridges were more subject to damage or destruction. Of course most of those undamaged were short single-span bridges, which were built to a high grade line with little extra cost, while long structures usually required a series of intermediate piers to be founded on river sands. But another contributing factor, as Mr. Kirkbride points out, was the record-breaking intensities of runoff from comparatively large drainage basins—intensities that should not occur more frequently than once in 1,000 years, if we can believe the results of ordinary frequency studies.

Except on routes of great utility, it is not economic to construct highway bridges to withstand these 1,000-year floods. Since flood failures seldom are hazardous to human life and outages need not cause great economic loss to users, costs of extra security must be balanced with the value of such extra security.

The survey included a classification of losses by proximate causes. Shallow foundations were responsible for 57%, shifting channels for 19%, inadequate waterways for 15%, and the failure of other struc-

tures upstream for 6%. Although this might indicate that piers should have been founded more deeply, adoption of this as a general policy would probably result in a much larger annual cost for the entire system. A more careful analysis of the data demonstrates that our flood losses are less than would result from optimum economy.

F. W. PANHORST, M. Am. Soc. C.E.
Bridge Engineer, California State Division of Highways

Sacramento, Calif.

Comments on Nationalization of the Railroads

TO THE EDITOR: Reading William J. Wilgus' article in the October issue of CIVIL ENGINEERING tempts me to send this:

Some sixty years ago I used to hear people say that if they could only live their lives over again, they would profit by their mistakes.

I resolved then and there that I would try to profit by other people's mistakes, to avoid making similar ones of my own, and to enjoy life as I went along.

So, if we can take a lesson from Canada's sad experience, it will save this country an annual loss of more than one billion dollars.

To make a long story short:

(*a*) The Canadian Pacific Railway Company operates about 21,000 miles of railroad, and the Canadian National Railway (government-owned) about 25,000 miles.

(*b*) When the Canadian Pacific Railway was spending $80 to earn $100, the Canadian National was spending $120 to earn $100—a good example of government ownership, as it was, is, and always will be.

(*c*) From the annual reports of the Canadian National Railway, the following was the system net loss:

In 1934	$ 89,662,352
1935	115,281,689
1936	92,311,037

The equivalent net loss for this country, which the taxpayers would have to stand, if all the railroads were owned by the government, would be considerably more than one billion dollars a year.

This is not half the story, if all that the Canadian Pacific Railway Company has done for Canada and the British Empire is considered.

T. KENNARD THOMSON, M. Am. Soc. C.E.

New York, N.Y.

The Economical Operation of Irrigation Systems

TO THE EDITOR: The writer has long been interested, particularly from the standpoint of the operating engineer or manager, in the conservation of water in connection with the operation of irrigation systems. The conclusions reached on the article by Clyde W. Wood on "Concrete Linings for Irrigation Canals," in the January issue, agree in principle with those arrived at by the writer, after many years of experience with irrigation problems in the West and Southwest.

After being employed on the Twin Falls North Side project in Idaho, I was a resident of Rupert, Idaho, on the Minidoka project of the U.S. Bureau of Reclamation. Before the completion of the latter project, it was found necessary to start construction of drainage improvements to remove excess irrigation water and to stop the spread of alkali. I had previously done some work on extensive drainage and flood control problems in western Iowa, and had considered irrigation to be the reverse of drainage. But on the Minidoka project I found that drainage must accompany irrigation.

In 1930 the farmers of the Mercedes District, in the Lower Rio Grande Valley of Texas, took over the 82,000-acre irrigation system from the owners, issuing bonds in payment for the system and also voting additional bonds for the improvement and rehabilitation of the works. At that time a considerable, and increasing, acreage of land in the District was water-logged and non-productive. Faced with a continually decreasing acreage of tillable land and the economic problems resulting therefrom, the governing body of the District decided to use the proceeds from the sale of the additional bonds in the construction of some 85 miles of 1-in. gunite canal lining and some 100 miles of open drains. This work was completed early in 1931 at a cost of approximately $1,100,000.

The lined canals, of semicircular section, were placed in one bank of the existing earth canals. Since the earth canals had been built for some time, they were well compacted and afforded an excellent foundation for the lining. Although only 2-in. free board was provided in these lined canals, little difficulty was experienced in operation. Maintenance costs averaged $5 to $7 per mile per year, seepage was reduced to a minimum, and some 15,000 acres of land were brought back into cultivation. The cost of water delivery and the quantity required per acre were materially decreased also.

Generally, the lining was placed in areas where the soils were sandy and readily susceptible to seepage, while the drains were installed in areas where the soils were heavy and tight. In my opinion, however, it will be necessary to provide a mileage of drains approximating that of the canals before adequate drainage is secured. In the region in question normal rainfall is about 29 in. per year. Much of this fall comes in large, quick rains and is of little value for irrigation.

In the Mercedes District, a charge was made for water, in addition to the tax imposed on an ad valorem basis for bond retirement. The water charge was divided into a "flat rate" or a "readiness to serve" charge and an acreage charge for each delivery of water. Depending on the crop, the rainfall, the farmer's requirement or on other exigency, the cost for water ranged from $2.25 to $10 per acre per year. Funds derived from this source were used for maintenance and operation of the system.

The statement quoted by Mr. Wood as to the farmer's lack of interest in the water duty is, alas, too true. Educating the farmer to appreciate the value of proper application and use of water has been going on for many years, with seemingly but little progress. Wasteful water users, both owner and tenant, will be found on every system.

C. L. HUFF, M. Am. Soc. C.E.

Los Angeles, Calif.

Pontoon Bridge Structures

TO THE EDITOR: Mr. Andrew's article on the Lake Washington Pontoon Bridge in the January issue shows, in Fig. 1, a half-section of a typical pontoon.

This section should be of particular interest to bridge engineers, not only in its special relationship to the Lake Washington Bridge but in its applicability to all concrete bridges. It exemplifies beautifully clean simple framing, free from offsets, stiffeners, and dire apprehensions. It can be formed and concreted with the utmost facility and economy. It recognizes the fact that slender vertical web members, which are rigidly held by wide horizontal slabs top and bottom, are adequately and sufficiently braced by slender transverse webs similarly framed. It is interesting to note that thus braced, three logitudinal webs 6 in. thick and two sides 8 in. thick—a total of 34 in.—furnished full longitudinal web section for a beam 59 ft wide.

It is true that in a pontoon structure most of the loads find their support directly beneath them, and no great amount of longitudinal transference occurs. Nevertheless, longitudinal waves may produce considerable longitudinal stress in this structure.

In addition to what may be called for in design drawings is the response thereto that comes on the job.

I have heard many statements as to the sheer impossibility of getting proper placement of concrete in thin deep sections. Admittedly it is not a matter of thickness alone. Whether webs are thick or thin a thoughtless arrangement of top bars that plugs up the top of a section will make proper placement of concrete a very difficult matter. But in this case, given the initial will and desire to use thin sections, it has been conclusively demonstrated that thoroughly reinforced webs, 6 in. thick and 11 ft 11 in. deep from fillet to fillet, can be placed without defect or flaw. This is an accomplished fact.

HOMER M. HADLEY, Assoc. M. Am. Soc. C.E.

Seattle, Wash.

SOCIETY AFFAIRS

Official and Semi-Official

Preview of the Spring Meeting—Kansas City, April 17-20

KANSAS CITY—"the Heart of America"—will play host to the Society for the first time in 14 years on the occasion of the 1940 Spring Meeting, April 17–20. With nine of the twelve Society Divisions represented, the main problem of the program committee has been how to crowd the widely varied technical sessions in with a minimum of overlapping, and still leave time for the social events and inspection trips that are an equally important part of such a gathering.

The technical program has been built up in large part around engineering problems of special importance in the so-called Mid-

DOWNTOWN KANSAS CITY, WITH THE NEW MUNICIPAL AUDITORIUM IN THE FOREGROUND

Continent Area—that part of the country extending roughly from the Rockies to the Mississippi-Ohio, and from the Canadian border to the Gulf. In line with this plan, the main theme of the general meeting on Wednesday will be "Resources of the Mid-Continent Area." The topics include:

Agricultural Resources
Water Resources
Industrial Development
Mineral Resources (including Gas and Oil)
Railroads

On Thursday morning, April 18, the Division sessions will begin. Complete details will be included in the program to be published next month, but arrangements are already sufficiently advanced to permit the following announcements:

CONSTRUCTION DIVISION

Heavy Foundation Construction—a review of the development and changes in methods and equipment
Problems of Pipe Line Construction (especially lines for the transportation of gases and liquids of petroleum products)
Design and Construction of Kansas City Municipal Auditorium

HIGHWAY DIVISION

Highway Developments in Missouri—to cover the planning survey and traffic needs in metropolitan areas
Trends of Highway Construction to Meet the Needs of Traffic Growth
Low-Coast Roads to Meet the Needs of Economy in Kansas
Soil Studies Applied to Highway Construction and Maintenance

SANITARY ENGINEERING DIVISION

Development of a Water Supply for Wichita, Kans.
Developments and Future Problems in Water Supply and Sanitary Sewage in the Mid-Continent Area
Trends in the Disposal of Sewage

POWER DIVISION

Problems in Power Development and Distribution, Including Production by Oil, Gas, Coal, and Water
Relative Availability, Cost, and Means of Production of Coal for the Generation of Power
Relative Availability, Cost, and Means of Production of Oil and Gas for the Generation of Power

With Thursday afternoon reserved for other affairs, the technical sessions will be resumed on Friday morning, with five Divisions on the list (two of them in joint session). The programs are:

HYDRAULICS DIVISION

Flood Problems of Kansas City
Hydraulics of Storm Drains on Large Urban Areas

ENGINEERING ECONOMICS DIVISION and CITY PLANNING DIVISION (JOINT SESSION)

Economic Considerations Involved in the Planning of Cities
Economics of Development in New vs. Old Areas

STRUCTURAL DIVISION

Symposium on Preparation and Reconditioning of Structural Steel Surfaces for Painting:

Introduction
Sandblast Cleaning of Structural Steel
Flame Cleaning vs. Sandblasting
Flame Cleaning Equipment and Gases
Reconditioning Surfaces Preparatory to Painting
Shop Painting a Protection for Structural Steel

SURVEYING AND MAPPING DIVISION

Program for Mapping the United States
Reconnaissance Surveys
Aerial Mapping

KANSAS CITY SKYLINE—LOOKING TOWARD THE UNION STATION FROM MEMORIAL HILL

WATERWAYS DIVISION

Development and Maintenance of a Navigable Channel in the Missouri River
Effect of Recent Cutoffs and Channel Improvement Work on Navigation on the Mississippi River
Modern Developments in Inland Waterway Tow Boats

INSPECTION TRIPS

The afternoons of Thursday and Friday, April 18 and 19, as well as Saturday April 20, will be occupied with inspection trips to points of engineering interest. Within easy reach are structural steel fabricating plants, wire-rope manufacturing plants, and cement mills. Two fine airports in the river bottoms, within ten minutes of the central business and industrial districts, will attract the attention of city planners especially, as will the Kansas City, Kans., market project and the justly famed residential developments, market centers, and parkways of the Country Club district. Sanitary engineers will find much of interest in the water-treatment plant, where especially difficult problems are met in the handling of the muddy Missouri River supply. There are also the light and power plants of both the Kansas Cities—and of course the great industrial district, with its stock yards, packing plants, and grain elevators.

SOCIAL FUNCTIONS AND LADIES' ENTERTAINMENT

Following the usual custom of Society programs, attractive social gatherings will be well distributed throughout the meeting. Plans are now taking final shape for evening entertainments on both Wednesday and Thursday, open to members and to their guests as well. Arrangements are also being made for the entertainment of the lady visitors throughout the day. A sight-seeing trip followed by tea at one of the country clubs, and a visit to the Kansas City Art Gallery and Institute, are part of the tentative schedule.

OTHER MEETINGS AND CONFERENCES

Preceding the Meeting proper, a Local Section Conference will be held on Tuesday, April 16, and concurrent with the Meeting, on April 17 and 18, will be the Conference of Student Chapters.

CAREFUL PLANNING AND RIGID CONTROL OF DEVELOPMENT HAVE MADE THE COUNTRY CLUB DISTRICT OF KANSAS CITY A RESIDENTIAL AREA THAT FEW CITIES CAN EQUAL

Other events of importance include the meetings of the Board of Direction (Monday, April 15) and of the Technical Procedure Committee (Tuesday, April 16).

Headquarters will be at the Hotel Continental, which has ample facilities for the meeting.

Utah Section Junior Forum Has Successful First Year

ONE OF THE most interesting and encouraging phases of Local Section development has been the formation in recent years of Junior branches within the Sections. So far there are thirteen such groups of Juniors functioning in as many different Sections. Typical of the interest of the younger engineers in these groups is the history of the recently formed Junior Forum of the Utah Section.

On June 9, 1939, T. C. Adams, president of the Utah Section, called a meeting of all Juniors in Salt Lake City and its vicinity to consider the possibility of organizing them into a group similar to those in other Sections. All of the eighteen persons present were in favor of such an organization, and a round-table discussion of methods of organization followed dinner. A committee of six—G. K. Borg, H. W. Dahl, A. J. Lazenby, M. N. McKendrick, A. W. Smith, and R. E. Van Liew (chairman)—was appointed to prepare an organization plan, and this committee met on June 22 and developed a complete plan of organization and procedure.

The plan and suggestions were in the main adopted by the Juniors at a meeting held on June 29, at which the following officers were elected: R. C. Haven, Jr., senior director; E. R. Morgan and R. E. Van Liew, directors; and A. W. Smith, secretary. Following the election, there was a round-table discussion on "The Green River Conservation Association" and on "Utah's Progress in Conservation Programs." The July meeting was devoted to discussion of plans for the future, while "Meteorology and Its Relation to Engineering" was the topic under consideration at the August meeting.

On September 26 members of the Forum met at the Great Salt Lake Yacht Club to hear President Adams describe the development of the Municipal Yacht Harbor and give an illustrated lecture on the history of Great Salt Lake. A buffet supper and moonlight sail completed the evening. In October the members met at the office of the U. S. Weather Bureau in Salt Lake City, where the functions of the meteorological station were explained. The group then motored to the Airport Weather Bureau for a general inspection trip. The last meeting of 1939 was held at the new Utah State Testing Laboratory, where B. W. Boguslavisky discussed soil mechanics and E. L. Armstrong described numerous criteria for safe dam construction. William F. Hughes conducted the group through the laboratory and explained its work.

On January 11 the Forum sponsored a meeting, to which the members of the Utah Section were invited. The speakers on this occasion were George D. Clyde, dean of the school of engineering at Utah State Agricultural College and newly elected president of the Utah Section, and B. F. Lofgren, assistant to the Utah state engineer.

The directing committee of the Forum for 1940 consists of E. R. Morgan, R. E. Van Liew, and Grant Borg, each of whom will serve as chairman for a four-month period.

Appointments of Society Representatives

HARRISON W. CRAVER has been reappointed the Society's representative on the American Documentation Institute for the three-year term beginning in January 1940.

JOEL D. JUSTIN, M. Am. Soc. C.E., has been appointed one of the Society's representatives on Engineering Foundation to fill the vacancy caused by the death of GEORGE E. BEGGS, M. Am. Soc. C.E.

HOWARD E. PHELPS, JOHN J. RICHEY, and ARTHUR J. TURNER, Members Am. Soc. C.E., have been appointed Society representatives on the Delegatory Committees of the Committee on Engineering Schools of the Engineers' Council for Professional Development.

NICHOLAS T. F. STADTFELD, M. Am. Soc. C.E., has been appointed a Society representative on the Sectional Committee on Specifications for Portland Cement to fill the vacancy caused by the death of THADDEUS MERRIMAN, M. Am. Soc. C.E.

ARTHUR S. TUTTLE, Past-President Am. Soc. C.E., has been appointed one of the Society's representatives on United Engineering Trustees, filling the vacancy caused by the resignation of JOHN P. HOGAN, President Am. Soc. C.E., whose term would have expired in October 1943.

Meeting of Outgoing Board of Direction—Secretary's Abstract

ON JANUARY 15 and 16, 1940, the outgoing Board of Direction met at Society Headquarters with President Donald H. Sawyer in the chair, and present George T. Seabury, Secretary; Past-Presidents Mead and Riggs; Vice-Presidents Pirnie, Ferebee, and Davis; Directors Agg, Anderson, Ayres, Bres, Brooks, Dean, DeBerard, Dunnells, Harrington, Hudson, Leeds, Legaré, Lewis, Needles, Parker, Root, Sawin, Shea, Stanton, and Treasurer Hovey.

Also present, by invitation, were members of the incoming Board, attending as observers, thereby gaining some familiarity with the problems they were about to face as members of the incoming Board.

Annual Report

In draft form, the Annual Report of the Board was presented for discussion. After explanation and comment, it was adopted. In its approved form, this report will appear in the Society Year Book for 1940, to be issued as Part 2 of the April PROCEEDINGS. Excerpts appeared in the February issue of CIVIL ENGINEERING.

Professional Conduct

Report was received from the Committee on Professional Conduct, and after discussion, action resulting in expulsion from the Society was taken in one case.

Judging Papers for Society Prizes

In line with the suggestions of a committee, the Board adopted rules for guidance of its Committee on Prizes in rating papers for the purpose of choosing those suitable for Society awards.

Charles D. Marx

The Board authorized appointment of a committee to prepare a memoir of Charles D. Marx, Past-President and Honorary Member of the Society. This committee, subsequently appointed, consists of Messrs. John D. Galloway, F. H. Fowler, S. B. Morris, Leon Reynolds, and C. B. Wing.

By-Laws Amended—"Article IV—Committees"

Following regular procedure, the Board considered a proposed amendment to the By-Laws, Article IV, relating to "Committees." After discussion, this section of the By-Laws was amended, to create a new committee of the Board on "Division Activities," discontinuing the Executive Committee of the Technical Procedure Committee, reconstituting the Committee on Technical Procedure to include the new Board committee, and describing its appropriate functions. The wording is given in detail elsewhere in this issue.

Factual Survey

Results of a postcard survey made during 1939 covering earnings and other data obtained from almost 8,000 members were described. The Board directed that these data with an analysis be published in CIVIL ENGINEERING (given in the February issue, page 122 and following).

Memoirs of Members

Discussion in the Board revealed the interest in memoirs of deceased members published by the Society and the need of continued efforts to maintain this desirable activity.

Local Sections

A number of matters were referred to the Board by the Committee on Local Sections for action:

1. An amended method for administering Local Section operations was approved.
2. The Seattle Section was authorized to encourage nearby members in the Province of British Columbia to affiliate with it.
3. Financial assistance was provided for Sections outside the United States in order that each might send a representative to one yearly Local Section conference.
4. Questions of the Section boundaries involving the Philadelphia, Buffalo, Pittsburgh, and Tennessee Valley Sections were discussed, and the boundaries were redefined in some cases.
5. Formation of a Tri-City Section, including the vicinity of Davenport, Iowa, Rock Island and Moline, Ill., was approved, with provision for necessary allotment.

An abstract of the report of the Committee on Local Sections for 1939 will be found elsewhere in this issue.

Boundaries of Districts and Zones

On report of the Committee on Districts and Zones, slight revisions in boundaries were made in Pennsylvania and Iowa to con-

1939 BOARD OF DIRECTION OF THE SOCIETY

Starting at near corner of table and proceeding clockwise: Enoch R. Needles, Director, District 1; T. Keith Legaré, Director, District 10; Daniel W. Mead, Past-President; William J. Shea, Director, District 1; Arthur W. Dean, Director, District 2; Robert B. Brooks, Director, District 14; Thomas R. Agg, Director, District 16; Henry E. Riggs, Past-President; W. W. De Berard, Director, District 8; E. S. Bres, Director, District 15; Harold M. Lewis, Director, District 1; Clifford G. Dunnells, Director, District 6; Glenn L. Parker, Director, District 12; L. E. Ayres, Director, District 7; Arthur W. Harrington, Director, District 3; J. E. Root, Director, District 9; James A. Anderson, Director, District 5; Sanford W. Sawin, Director, District 4; James L. Ferebee, Vice-President, Zone III; Otis E. Hovey, Treasurer; Carolina Crook, Secretary to Mr. Seabury; George T. Seabury, Secretary; Donald H. Sawyer, Past-President; H. W. Hudson, Director, District 1; Charles T. Leeds, Director, District 11; R. P. Davis, Director, District 6; Malcolm Pirnie, Vice-President, Zone I; and Thomas E. Stanton, Jr., Director, District 13.

form to the revised boundaries of the Local Sections, as noted elsewhere in these pages.

Student Chapters

On recommendation of the Committee on Student Chapters, authority was given to forward "letters of commendation" to 12 Chapters for meritorious work during the year. The list of Student Chapters so honored is given on another page.

Approval was also given for the establishment of Student Chapters at Colorado State College, Northeastern University (Boston) and Southern Methodist University (Dallas, Tex.).

Clarification of the term, "Schools of Engineering of Recognized Reputation," was adopted as noted elsewhere in this issue.

Retirement System

It was reported that the new retirement system for Society employees was in operation, providing for joint contributions by the Society and the employees.

Engineering Compensation

Communications from Local Sections were received in comment on the grading plan and compensation schedule adopted by the Board at San Francisco in July 1939 (see September CIVIL ENGINEERING, pages 566–568). After full discussion, it was voted that the minimum service requirement for each of the three lowest professional grades be reduced on this schedule by two years. An item elsewhere in this issue gives further details.

Budget

Various items in the budget proposed for 1940 were discussed and in some instances amended. The new budget was then approved for recommendation to the incoming Board.

Engineering Societies Employment Service

The status of the Engineering Societies Employment Service as an independent agency, controlled by the Societies, was discussed. In line with similar proposed action by other societies, the Board approved the reconstitution of this work as a non-profit corporation, and designated the Society's representative and the means for making the change.

Miscellaneous

During the several sessions, reports of various committees and officers were received and discussed, with suitable action in each instance.

Adjournment

After appropriate remarks by those who were concluding their last meeting, the Board adjourned.

Meeting of the Incoming Board of Direction—Secretary's Abstract

THE BOARD of Direction met at the Headquarters of the Society on January 18, 1940, with President John P. Hogan in the chair; and present George T. Seabury, Secretary; Past-Presidents Riggs and Sawyer; Vice-Presidents Ferebee, Davis, Jacobs and Lucas; Directors Agg, Anderson, Ayres, Blair, Bres, Brooks, DeBerard, Dunnells, Goodrich, Harrington, Hudson, Hyde, Leeds, Lewis, Parker, Polk, Root, Sawin, White, and Treasurer Hovey.

This comprised a complete attendance for the first meeting of the new Board.

Budget

The budget for 1940 as recommended by the outgoing Board was presented. A number of items were discussed and minor revisions were incorporated. The Society budget for 1940 was then adopted, showing a small prospective surplus for the proposed year's operations.

Myddelton Cup

Attention was directed to the official presentation in Washington from the hands of Lord Lothian, British Ambassador, of the Myddelton Cup from the Institution of Civil Engineers. This presentation had originally been planned for the British American Engineering Congress in September, which Congress was canceled at the last minute. The Board adopted a resolution of appreciation to the Institution of Civil Engineers and directed that a copy be sent to the British Ambassador. Detailed wording of the resolution is noted elsewhere in this issue.

Board Procedures

Routine of the Board in handling various matters was detailed for the benefit of new members.

Committees Appointed

On suggestion of the President, the Board approved appointments for committee membership during 1940, as follows:

EXECUTIVE COMMITTEE: John P. Hogan, *Chairman;* George L. Lucas, *Vice-Chairman;* Henry E. Riggs, Donald H. Sawyer, and James L. Ferebee.

COMMITTEE ON HONORARY MEMBERSHIP: John P. Hogan, *Chairman;* Henry E. Riggs, Donald H. Sawyer, James L. Ferebee, Roland P. Davis, Joseph Jacobs, and George L. Lucas.

COMMITTEE ON DISTRICTS AND ZONES: James A. Anderson, *Chairman;* Joseph E. Root, Harold W. Hudson, Charles G. Hyde, and Armour C. Polk.

COMMITTEE ON PROFESSIONAL CONDUCT: Arthur W. Harrington, *Chairman;* Thomas R. Agg, Edward S. Bres, Charles T. Leeds, Armour C. Polk, and James A. Anderson.

COMMITTEE ON PUBLICATIONS: Thomas R. Agg, *Chairman;* Harold M. Lewis, Lewis E. Ayres, Charles T. Leeds, and Lazarus White.

COMMITTEE ON MEMBERSHIP QUALIFICATIONS: Joseph E. Root, *Chairman;* Arthur W. Harrington, Edward S. Bres, Robert B. Brooks, Ernest P. Goodrich, and Charles G. Hyde.

COMMITTEE ON DIVISION ACTIVITIES: James L Ferebee, Senior Vice-President; Joseph Jacobs, Senior Vice-President next year; Thomas R. Agg, Chairman, Committee on Publications: Robert B. Brooks, Board member; and W. W. DeBerard, Board member.

MEETING COMMITTEES:

Annual Meeting: George L. Lucas, *Chairman;* Harold M. Lewis, Harold W. Hudson, Ernest P. Goodrich, and Lazarus White.

Southern Meeting (Spring): James L. Ferebee, *Chairman;* Lewis E. Ayres, W. W. DeBerard, and Robert B. Brooks.

Annual Convention (Summer): Joseph Jacobs, *Chairman;* Charles G. Hyde, Charles T. Leeds, and Glenn L. Parker.

Northern Meeting (Fall): Roland P. Davis, *Chairman;* Edward S. Bres, Arthur W. Harrington, Clarence M. Blair, and Joseph E. Root.

COMMITTEE ON TECHNICAL PROCEDURE: James L. Ferebee, *Chairman;* Joseph Jacobs, Thomas R. Agg, Robert B. Brooks, and W. W. DeBerard, all members of the Committee on Division Activities; also Harland Bartholomew, Chairman, City Planning Division; John W. Cowper, Chairman, Construction Division; William N. Carey, Chairman, Highway Division; Fred C. Scobey, Chairman, Hydraulics Division; S. T. Harding, Chairman, Irrigation Division; William P. Creager, Chairman, Power Division; Earle L. Waterman, Chairman, Sanitary Engineering Division; Carlton S. Proctor, Chairman, Soil Mechanics and Foundations Division; Charles F. Goodrich, Chairman, Structural Division; William Bowie, Chairman, Surveying and Mapping Division; and W. G. Atwood, Chairman, Waterways Division.

COMMITTEE ON PROFESSIONAL OBJECTIVES: Wilford W. DeBerard, *Chairman,* term ending January 1941; Frederic Bass, term ending January 1941; Robert B. Brooks, term ending January 1942; Ivan C. Crawford, term ending January 1942; Henry L. Fruend, term ending January 1942; Clifford G. Dunnells, term ending January 1943; and A. M. Rawn, term ending January 1943.

COMMITTEE ON LOCAL SECTIONS: James W. Follin, *Chairman,* term ending January 1941; J. T. L. McNew, term ending January 1942; W. M. Spann, term ending January 1943; Hal Hale, term ending January 1944; and C. T. Leeds, *Contact Member.*

COMMITTEE ON JUNIORS: Scott B. Lilly, *Chairman,* term ending January 1941; E. Warren Bowden, term ending January 1942; O. C. Reedy, term ending January 1943; F. V. Ragsdale, term ending January 1944; and Clifford G. Dunnells, *Contact Member.*

COMMITTEE ON STUDENT CHAPTERS: A. H. Holt, *Chairman,* term ending January 1941; John H. Porter, term ending January 1942; E. M. Hastings, term ending January 1943; Clarence L. Eckel, term ending January 1944; and Charles G. Hyde, *Contact Member.*

COMMITTEE ON ENGINEERING EDUCATION: Samuel B. Morris, *Chairman,* term ending January 1941; T. C. Adams, term ending January 1942; L. S. LeTellier, term ending January 1943; James A. Anderson, term ending January 1944; and T. R. Agg, *Contact Member.*

COMMITTEE ON FEES: Frank A. Marston, *Chairman,* term ending January 1941; Walter L. Huber, term ending January 1942; Ernest E. Howard, term ending January 1943; Louis R. Howson, term ending January 1944; Edward N. Noyes, term ending January 1945; and Clarence M. Blair, *Contact Member.*

COMMITTEE ON PUBLIC INFORMATION: Harry L. Kinsel, *Chairman*, term ending January 1941; E. O. Sweetser, term ending January 1942; Walter D. Binger, term ending January 1943; Lewis C. Wilcoxen, term ending January 1944; and Sanford W. Sawin, *Contact Member*.

COMMITTEE ON REGISTRATION OF ENGINEERS: J. H. Dorroh, *Chairman*, term ending January 1941; Wm. C. E. Becker, term ending January 1942; L. M. Martin, term ending January 1943; T. Keith Legare, term ending January 1944; and Armour C. Polk, *Contact Member*.

COMMITTEE ON SALARIES: Dean Edwards, *Chairman;* Thomas E. Stanton, Jr., Thomas R. Edmonston, Charles S. Shaughnessy, W. W. DeBerard, Donald H. Sawyer, and Harold W. Hudson, *Contact Member*.

COMMITTEE ON SECURITIES: Malcolm Pirnie, *Chairman;* George L. Lucas, and Ralph R. Rumery.

COMMITTEE ON RETIREMENT SYSTEM: William J. Shea, Member-at-large, *Chairman* (4-year term); Lazarus White, Board member for term of office on Board; and Carl E. Beam, Staff Representative.

Adjournment

The Board adjourned to meet in Kansas City, Mo., on April 15, 1940.

Amendment to "Grading Plan and Compensation Schedule for Civil Engineering Positions, Lower Professional Grades"

MONTHS OF STUDY by the Society's Committee on Salaries crystallized into definite recommendations a year ago. A redrafted plan based on numerous recommendations by Local Sections and members, was adopted by the Board of Direction at its 1939 summer meeting and was printed in the September issue of CIVIL ENGINEERING, pages 566–568, entitled "Grading Plan and Compensation Schedule for Civil Engineering Positions."

By action of the Board of Direction at its January 16, 1940, meeting, this schedule was changed as to minimum service requirements governing "Professional Grades I, II, and III." The vote of the Board was that the experience requirements be reduced by two years for each of these three grades.

The effect of these changes can be best illustrated by reference to "Professional Grade I," in which, under paragraph C-1, the necessary education and experience was formerly given as (*a*) graduation plus at least two years of engineering experience, or (*b*) completion of high school work plus additional self-improvement totaling at least eight years of engineering experience, or (*c*) any equivalent combination of education and experience.

According to the experience requirement revised by recent Board action, paragraph C-1 applying to Professional Grade I, will now require:

"1. *Education and Experience:* (*a*) graduation with a degree in civil engineering from an engineering school on the accredited list of Engineers' Council for Professional Development, or (*b*) completion of the twelfth (high) school grade, *additional self-improvement through study of technical engineering subjects*, and in general the equivalent of at least six years' experience on engineering work, or (*c*) any equivalent combination of education and experience."

Both Professional Grades II and III depend on Grade I for their experience requirements, specifying, respectively, two and four years' additional experience. Accordingly, the statements of Grades II and III will need no change. But it is emphasized that the change incorporated in Grade I applies to all three grades, reducing the minimum service requirement by two years in each instance.

It is of interest also to note that by action of the Board at the same meeting, the Committee on Salaries was instructed to initiate promptly a study of salaries applicable to engineers in higher grades and to civil engineering teachers. Factual data on the 1938 salaries, as gained from a questionnaire returned by almost 8,000 members, was given in the February issue, pages 122–124.

Wisconsin Engineers to Hold Conference in March

THE WISCONSIN Section of the Society, as one of the participating organizations, extends a cordial invitation to all interested to attend the 1940 Engineering Conference, which will be held at the Pfister Hotel in Milwaukee, March 13 to 15. The conference includes civil, mechanical, chemical, electrical and automotive engineers, and architects. Thus, writes Lloyd D. Knapp, secretary-treasurer of the Wisconsin Section, "it gives an opportunity for engineers in widely separated vocations to get together, become acquainted, and to realize that we do have common problems." Attendance last year was over 900, and is expected to be larger this year as more groups are taking part.

Under direct sponsorship of the Wisconsin Section is the buffet luncheon for all engineers and their ladies on Wednesday March 13. The Section is also in charge of the Wednesday afternoon meeting, which will include papers on "Low-Cost Highways" and "The Pennsylvania Turnpike."

Society Business Meeting to Be Held March 20

A REGULAR business meeting of the Society will be held in the Engineering Societies Building, 33 West 39th Street, New York, N.Y., on the evening of March 20, 1940, at 8 p.m. The purpose of the meeting is to canvass the ballots on the proposed amendments to the Constitution. This announcement is made in compliance with the requirement of the Constitution that Corporate Members shall receive official notice 15 days in advance of the meeting.

The business meeting, called solely for the purpose stated, will immediately precede the regular monthly meeting of the Metropolitan Section of the Society.

Forecast for March "Proceedings"

FOUNDATION EXPERIENCES, TENNESSEE VALLEY AUTHORITY: A SYMPOSIUM

An assembly of data pertaining to geology and allied experiences in the preparation of foundations for dams, as typified by three outstanding cases.

FOUNDATION TREATMENT AND RESERVOIR RIM TIGHTENING AT NORRIS DAM

By James E. Lewis, Jr.

Methods of overcoming adverse conditions at a dam site, so as to make an apparently infeasible dam site a feasible one.

FOUNDATION EXPLORATION AND GEOLOGIC STUDIES AT GUNTERSVILLE DAM

By Robert M. Ross

Problems of adapting a sedimentary rock foundation to use as a dam site.

FOUNDATION CONDITIONS AND TREATMENT, GUNTERSVILLE DAM

By Verne Gongwer, M. Am. Soc. C.E.

Description of engineering and construction problems, with special emphasis on ground-water flow.

FOUNDATION EXPLORATION AND GEOLOGIC STUDIES, CHICKAMAUGA DAM

By Portland P. Fox

Description of the logging, correlating, and plotting of all available data from many hundreds of core drill holes as a guide to construction.

FOUNDATION TREATMENT AT CHICKAMAUGA DAM

By James B. Hays, M. Am. Soc. C.E.

Grouting to fill cavities, channels, seams, faults, and folds, so as to make them watertight.

The Federal Engineer and the American Society of Civil Engineers

By HERMAN STABLER, M. AM. SOC. C.E.

A COMPILATION made by American Engineering Council shows that according to the census of 1930 there were in the United States 226,136 persons who called themselves technical engineers, of whom 102,057 called themselves civil engineers or surveyors. Those so enumerated probably include many persons that do not possess the qualifications for connection in lowest grade with the American Society of Civil Engineers or the more searching qualifications required for classification as an engineer of lowest grade in the federal service.

The federal budget estimate for the current fiscal year (1940) shows that there are employed in the federal service 11,392 persons who hold engineering positions classified as such in the professional service under the federal system of classification. The payroll for these employees amounts to $35,287,000 a year, the average annual salary being $3,097. There are also employed 12,047 persons with average salary of $1,860 a year and annual payroll of $22,420,000 who hold positions classified in the subprofessional service and perform work which is incident, subordinate, or preparatory to professional engineering and who are not required to be qualified as engineers to the extent of having the broad professional training represented by graduation from a college or university of recognized standing with major work in engineering. Nevertheless, many persons in these positions are so qualified and are likewise qualified for membership in the American Society of Civil Engineers. The federal entrance salary to the lowest-grade position classified in the professional service is $2,000 per annum. This is also the entrance salary to subprofessional grade 6. Those employed in subprofessional grades 6, 7, and 8 are recognized as performing work as valuable as though performed in professional grades 1 and 2. In general, those in charge of survey projects, supervisors of construction, inspectors of materials or important construction, higher-grade draftsmen, and the like, are actually performing engineering work but within a rather constricted field for which broad engineering training is not essential. In subprofessional grades 6, 7, and 8 there are 3,784 employees with average salary of $2,290 per annum and aggregate annual payroll of $8,674,000. It will probably be reasonably accurate to assume that nearly all federal engineering employees in positions classified in the professional or subprofessional services would be subject to the census classification as civil engineers or surveyors and that nearly all such employees in the professional service or in grades 6 to 8 of the subprofessional service are qualified for connection with the American Society of Civil Engineers.

Summarizing and construing the foregoing, together with information in the Am. Soc. C.E. Year Book, it would seem that the field of potential connection with the American Society of Civil Engineers would be about as follows:

Total qualified for Am. Soc. C.E. connection	65,000
Total in federal service so qualified	15,000
Total with Am. Soc. C.E. connections	16,000
Total in federal service with Am. Soc. C.E. connections .	3,200

These approximations suggest that about 23% of all civil engineers and surveyors qualified for connection with the American Society of Civil Engineers are in federal service and that about 20% of those who have made the connection are in federal service. There remains a wide field for membership connection both inside and outside the federal service. It may be concluded that in the conduct of Society affairs the responsible management should give due consideration to the interests of engineers in federal service and that a considerably larger number of engineers in federal service (15,176 with average annual salary of about $2,900 and total payroll of about $44,000,000) might very well make connection with the Society and support its activities.

CORPS OF ENGINEERS, U.S.A.

The federal agency that employs the greatest number of classified engineers is the Corps of Engineers, U.S.A., which requires the services of many engineers in river and harbor and in flood-control work. The budget for 1940 shows 2,465 professional engineering positions with average annual salary of $2,982 and 6,158 subprofessional engineering positions with average annual salary of $1,860 under this agency. Of the subprofessional positions, 1,654 are in grades 6, 7, and 8 with average annual salary of $2,290. Administration of this agency is in the hands of Army officers, and the civilian engineer therefore has little opportunity to rise to the higher grades. Only four civilian employees are in grades 7 and 8 and none are in grade 9.

BUREAU OF RECLAMATION

The second largest federal employer of engineers is the Bureau of Reclamation, whose chief function is the construction and operation of irrigation systems in the West. The budget of this agency for 1940 lists 1,272 professional and 1,842 subprofessional engineering positions with average annual salary of $2,904 and $1,830, respectively. Of the subprofessional positions 622 with average annual salary of $2,320 are in grades 6, 7, and 8. Though employing only about half as many professional engineers as the Corps of Engineers, 14, or 3½ times as many, are in grades 7 to 9 inclusive. A greater proportion of the reclamation engineers (74% as against 65%), however, are in grades 1 and 2.

CIVILIAN CONSERVATION CORPS

According to the budget for 1940, the Civilian Conservation Corps employing 946 professional engineers with average annual salary of $2,212, and 784 subprofessional men with average annual salary of $1,810, is the third largest federal employer of engineers. As might be expected from the nature of the engineering work performed, about 78% of the professional employees are in grade 1 and none are in grades higher than 5. Of the subprofessional men, 167, with average annual salary of $2,210, are in grades 6, 7, and 8.

BUREAU OF PUBLIC ROADS

The budget for 1940 lists 874 professional engineering positions with average salary of $3,281 and 697 subprofessional positions with average salary of $1,790 in the Bureau of Public Roads, which is the fourth largest federal engineering agency. This bureau has 14 of its professional engineers in grades 7 and 8 and none in grade 9. Only 44% of the professional employees are in grades 1 and 2. Of the subprofessional men, 218, with average annual salary of $2,290, are in grades 6, 7, and 8.

SOIL CONSERVATION SERVICE

Currently the fifth largest federal engineering agency is the Soil Conservation Service, whose engineers are engaged in up-

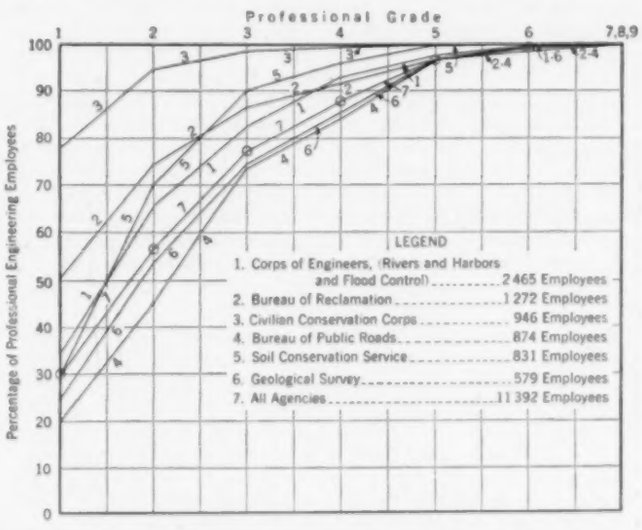


FIG. 1. PERCENTAGE OF PROFESSIONAL ENGINEERING EMPLOYEES, CUMULATIVE BY GRADES, IN FEDERAL AGENCIES EMPLOYING MORE THAN 500 PROFESSIONAL ENGINEERS

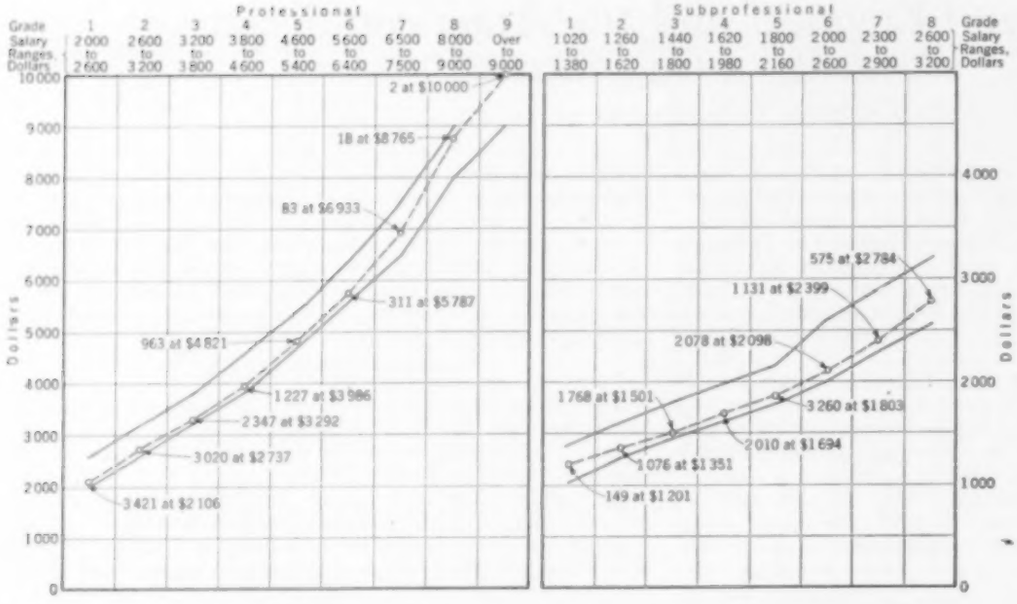


FIG. 2. SALARY RANGE, BY GRADES UNDER THE FEDERAL CLASSIFICATION SYSTEM, AND NUMBER OF EMPLOYEES, AND AVERAGE SALARY PAID IN EACH GRADE TO FEDERAL PROFESSIONAL AND SUBPROFESSIONAL EMPLOYEES ENGAGED ON ENGINEERING WORK

stream engineering activities and in construction of the minor works required in the delay of erosion. This agency employs 831 professional engineers with average annual salary of $2,716 and 577 subprofessional men with average annual salary of $1,690. None of the professional engineers are in grades higher than 6, and 92 of the subprofessional men with average annual salary of $2,120 are in grades 6, 7, and 8.

GEOLOGICAL SURVEY

Though organized as a scientific agency and administered by scientists, the Geological Survey is the sixth largest engineering agency of the federal government, its engineers being mainly employed in water-resources investigations and in topographic mapping. The Geological Survey employs 579 professional engineers with average annual salary of $3,119, 53% of whom are in grades 1 and 2, 3 of whom are in grade 7, and none of whom are in grades 8 or 9. The Survey also employs 62 subprofessional men with average annual salary of $2,020 on engineering work, of whom 43, with average annual salary of $2,170, are in grades 6, 7, and 8.

OTHER AGENCIES

There are many other federal agencies that employ less than 500 engineers each. In the aggregate these agencies employ 4,425 professional engineers at an average annual salary of $3,440 and 1,927 subprofessional men on engineering work with average salary of $1,993. Sixty-eight of the professional engineers are in grades 7 to 9, inclusive, and 988 of the subprofessional men are in grades 6, 7, and 8, with average annual salary of $2,321. Still other agencies, such as the Federal Housing Administration, Federal Works Agency, Reconstruction Finance Commission, Tennessee Valley Authority, Farm Security Administration, and Farm Credit Administration, employ in the aggregate a thousand or more engineers who are not classified under the Act of 1923 and are not covered by the enumerations in this article.

GRAPHICAL STUDIES

Figure 1 shows the percentage of employees in the several grades employed by the principal federal engineering agencies. Relative desirability, from the salary viewpoint, of these agencies for a career engineer, can be adjudged from the curves shown. The Bureau of Public Roads and Geological Survey stand out as better, and the Civilian Conservation Corps and Soil Conservation Service stand out as poorer than average. The Bureau of Reclamation has a large percentage of employees in higher grades but stands out as poorer than average in grades 4 and below. The Corps of Engineers provides the largest field for engineers, but a large percentage of employment is in the lower grades and there is no opportunity to reach the top.

Figure 2 shows by grades the range of salary, and the number and average salary of engineers engaged on professional and sub-professional work in the federal service. It is notable that the average salary is relatively close to the minimum. This is because (1) of a statutory prohibition against the average salary of employees in any grade exceeding the average salary of the grade; (2) a Congressional policy of reluctance to provide appropriations for promotion within grade on the basis of efficiency; and (3) a moderately liberal administrative policy in following the statutory requirement that employees who take on added responsibilities and perform more important and more difficult tasks shall be reclassified in an appropriate higher grade. Where the nature of the work offers opportunity, there is reasonably rapid progress from grade to grade coupled with undeservedly slow progress from one salary step to another in the absence of change of responsible character of duties performed.

Figure 3 has been prepared from statistics relating to federal engineers and from Table VII of the "Factual Survey of Members" on page 124 of CIVIL ENGINEERING for February. It shows that for the lower third in number, engineers in federal service receive greater remuneration than members of the Society generally. For the remainder—those with income of more than about $2,600—the federal engineer receives remuneration less than members of the Society generally. Whereas 22.5% of the members of the

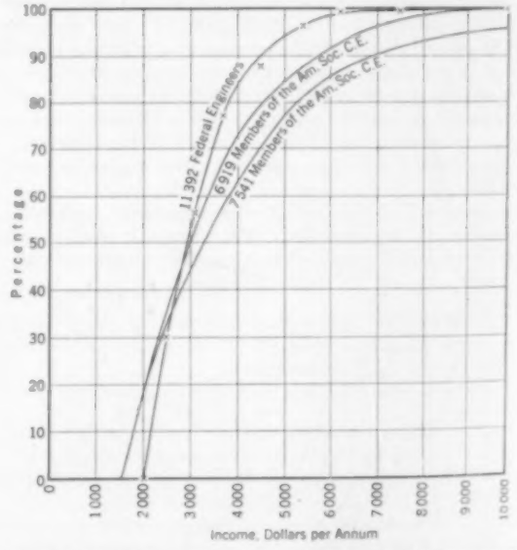


FIG. 3. PERCENTAGE, AT VARIOUS INCOME LEVELS, OF 11,392 FEDERAL ENGINEERS, OF 7,541 MEMBERS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS, AND OF 6,919 MEMBERS OF THE SOCIETY WITH INCOMES OF LESS THAN $10,000 PER ANNUM

American Society of Civil Engineers reporting receive income of more than $5,000 per annum, only about 6% of federal engineers are in that preferred class and none are paid more than $10,000 per annum, a rate of income exceeded by 4.2% of members reporting. If the comparison with federal engineers be limited to members of the Society receiving less than $10,000 per annum, about half the federal engineers (or those receiving less than about

$3,000 per annum) receive more income than members of the Society generally, while for the remainder the reverse is true.

These comparisons confirm the general rule that federal salaries are better in the lower ranges and poorer in the higher ranges, more attention being given to the minimum living wage concept.

CORRELATION OF FEDERAL CLASSIFICATION WITH MEMBERSHIP QUALIFICATIONS

The American Society of Civil Engineers has set up a classification for membership based on minimum qualifications of training and experience. The Committee on Membership Qualifications considers the record of an applicant and classifies him for one grade or another on the basis of qualifications shown. This is a classification of men.

The U.S. Civil Service Commission, under statutory direction, has set up a classification of work based on difficulty and importance of duties performed and responsibilities exercised and on minimum qualifications of training and experience considered requisite as a precedent to proper performance. This is a classification of positions.

Obviously there is interrelationship though imperfect correlation between these two systems of classification. No matter how wonderful a man's engineering training and experience may be, if and when making a simple instrumental survey he is engaged in subprofessional work or in professional work not higher than federal grade 1. Thus there may be an engineer classified as Member, Am. Soc. C.E., who holds a position as Junior Engineer in the federal service. Such a situation, of course, would be unusual and probably temporary. In course of time ability developed through training and experience will find its level, always provided there is work at that level to be performed and for which payment can be rendered.

It is reasonably accurate to state that engineers holding federal positions have been tested and tried to the extent that:

1. Those in grades 1 and 2 and most of those in grade 3 are qualified as Junior but not as Associate Member;
2. Some in grade 3, nearly all in grade 4, and some in grade 5 are qualified as Associate Member but not as Member; and
3. Some in grade 4 and nearly all in grades 5 to 9, inclusive, are qualified as Members.

Board Resolution Re Myddelton Cup

INTERESTING details regarding the Myddelton Cup and the presentation of a replica to the Society by Lord Lothian, British Ambassador, on behalf of the Institution of Civil Engineers were recounted in the February issue. As a formal acknowledgment of its gratitude, the Board of Direction at its January 18 meeting authorized the following resolution:

"WHEREAS: There has existed between The Institution of Civil Engineers of London, England, and her sister organization, the American Society of Civil Engineers, a spirit of friendliness through the years, and

"WHEREAS: This spirit prompted the Institution to forward to her sister society in America, a replica of the beautiful golden Myddelton Cup, which is one of the oldest symbols of recognition of the civil engineer and his work, dating from the seventeenth century, and

"WHEREAS: It was not possible, because of European conditions, to present this cup in September 1939 when it was planned to have a British-American Engineering Congress, and

"WHEREAS: Such presentation ceremonies were held in Washington, D.C., when the British Ambassador, Lord Lothian, formally presented the cup to the President of the Society on January 9, 1940, and

"WHEREAS: This gracious expression of regard is heartily reciprocated,

"*Be it resolved:* That the Board of Direction of the American Society of Civil Engineers in meeting assembled at Society Headquarters in New York City on January 18, 1940, expresses its sincere appreciation to the institution for this beautiful gift, which will ever be a cherished possession of the Society, and will serve as a token of the high regard and mutual esteem of each for the other."

Copies of this resolution have been forwarded to the President of the Institution in London and to Lord Lothian in Washington.

Accrediting of Schools Is Prerequisite for Student Chapters

IN THE PAST the Society By-Laws, Article V, "Student Chapters," have provided that Chapters may be formed in "schools of engineering of recognized reputation." No exact definition of status has been given this requirement, but the interpretation has been left to the proper committee of the Board, on whose report the Board has based its decision.

It has seemed to the Society's Committee on Student Chapters that a better, more definite method is now available. Accordingly, the committee made the following suggestion to the Board:

"The Committee on Student Chapters unanimously recommends that the phrase '...schools of engineering of recognized reputation...' in Article V, Section 1, of the Society By-Laws, be interpreted to mean schools having a curriculum in civil engineering accredited by the Engineers' Council for Professional Development and leading to a degree of Bachelor of Science in Engineering or its equivalent.

"This Committee recognizes the right of the Board of Direction to elect a 'Military, Naval, Mining,' etc., or 'other professional engineer' to membership in the Society under the Constitution but believes that Student Chapters of the American Society of Civil Engineers should not be maintained in any school which does not have an accredited curriculum in Civil Engineering. This action would not prevent other engineering students from joining the Student Chapter if they so desired.

"While no statement to this effect is definitely made in the Constitution or By-Laws of the Society, it is implied in Article V, Section 2 (*b*) in which one of the qualifications required of a proposed Student Chapter is, 'The endorsement of the application by the head of the civil engineering department.'

"The Committee is also of the opinion that some stand in the matter should be taken if the Society is to give its full support to the accrediting program of the Engineers' Council for Professional Development of which it is a member."

This suggested interpretation of requirements for Society Student Chapters was adopted by the Board at its meeting on January 16, 1940.

In and About the Society

TWINS by birth, Howard Charles Wickes and Gordon Frank Wickes are also "twins" in the records of the Society. Twenty years ago they were admitted as Associate Members on the same day, and in January 1940 they were both transferred to the full grade of Member—again on the same day. They are, respectively, secretary-treasurer and president of the Wickes Engineering and Construction Company.

* * * *

"I THOUGHT you would be interested in knowing about the reception accorded my article," writes a contributor to one of last year's issues of CIVIL ENGINEERING. "As a result of it, I have received about forty letters expressing interest, discussing various phases, or asking for more information. These letters came from coast to coast and have made many new friends for me. In addition, fully double that number have discussed the article with me personally. It was surprising to find that some of this interest came from men who are not members of the Society."

* * * *

THE University of Alabama Student Chapter, with the assistance of the Chapter at Alabama Polytechnic Institute, will be host to the Southeastern Conference of Student Chapters at Tuscaloosa, Ala., on March 14 and 15. Details of the program are still to be completed, but it has been announced that A. C. Polk, Director of the Society, will speak on the subject, "Some Experiences with Young Engineers," at 11 a.m. on Thursday and that D. H. Barber, district engineer for the Water Resources Branch of the U.S. Geological Survey, will discuss "Government Civil Service as a Career for Young Engineers" at 11:30 a.m. on the same day. Engineering exhibits and social events, climaxed by the annual Engineers' Ball, will comprise the program on the 15th.

Local Sections in Review

Abstract of Report of Committee on Local Sections, Presented to Board of Direction on January 13, 1940

IN PRESENTING its Annual Report for 1939 to the Board of Direction in January, the Committee on Local Sections first reviewed briefly the development of the Society's financial support of Local Sections.

Originally known as "Local Associations of Members," the first such association was authorized by the Board of Direction in the year 1905 at the request of members of the Society in San Francisco. This form of local organization expanded to 23 in number by 1921.

In 1918 the Board appointed the Committee on Development, which recommended a plan to the Board in 1919 to broaden the activities of the Society. This plan was submitted to the membership by the Board in the form of a questionnaire.

As one result of the questionnaire, the membership voted by a large majority ($3^1/_2$ to 1) to create Local Sections to embrace the entire membership of the Society. This has been done, step by step, and finally was accomplished with respect to the United States in 1938. In April 1920, the Board of Direction approved the use of the term "Section" in referring to the previously designated "Local Associations" when it authorized the formation of the New York Section. The revised Society Constitution of 1921 provided in Article IX for the assignment of funds to the Sections in accordance with their needs, but not to exceed $3 per member belonging to the Section. In 1922 the Board made its first assignments to the Sections based on the matching of dues collected locally. The Pittsburgh Section was the first to receive its remittance under this plan and the total amount assigned to the Sections in 1922 was $2,886. The Society's assignment on the "dues-matching basis" gradually increased year by year and reached a peak of $13,697 in 1931. In 1937, the last year in which assignments were made on the "dues-matching basis," it equalled $11,496.

In the five years following the report of the Committee on Development, the number of Local Sections doubled. By 1937 there were 61 Sections. Some were organized along state lines; others were centered on some large metropolitan city. There were wide open spaces between them. At the beginning of 1938, the final major step was taken in Local Section organization and in its financial support. The territorial gaps between the Sections were closed up; today every part of the United States lies within the area of influence of some one of our 63 Local Sections, and every Society member resident in the United States belongs to one of the Sections.

In January 1938 the Board adopted definite principles and a formula by which assignments to Local Sections were determined. The new plan, the 1938 procedure, under which the Sections are now operating, provides that the Board of Direction

> "shall assign to each Local Section from the funds of the Society in January of each year, a sum equal to $50, plus $1.50 for each member deemed to belong to the Section and plus an amount equal to the regular dues collected by the Section in its fiscal year next preceding."

This sum is limited, by Constitutional provision, to $3 per member and is subject to any restrictions the Board may make uniformly applicable. Since January 1, 1938, a uniform factor of 60% has been applied to the formula.

For guidance and for assistance in administration, certain rules, "Method of Administering Local Section Operations," were approved by the Board in 1938.

All members of the Society thus automatically belong to the Section in the area of influence in which they reside; they receive all communications and meeting notices of the Section to which they belong and have the privilege of attending all Section meetings. However, more active participation in the administration of a Section and closer connection with its professional and technical work than simple attendance at meetings, is usually desired by members. To become active to this extent, those who belong to a Section must "subscribe" to the Section's constitution, and pay whatever local dues are designated. They are then subscribing members, or active members, and as such are entitled to vote on Section matters, hold Section office, serve on Section committees, and in other ways make local contribution to the work the Society is carrying forward. Local dues vary from $1 to $3 per year and average just under $2 per subscribing member.

Members of the Society resident in Canada and Mexico can belong to an existing Section within the United States if they desire, by making request to the Society Headquarters and by "subscribing" to the constitution of the Section.

OBSERVED RESULTS FAVORABLE

The immediate effect of adopting the 1938 procedure has been a material increase in the amount the Sections have had available for their support. In 1937, under the old plan, the Society's contribution was $11,496; in 1938, under the new plan, it was $20,395—an increase of nearly $9,000. The aggregate amount in 1938 ($30,951) is nearly $8,000 larger than the aggregate amount available to Sections in 1937 ($23,132).

The important consideration is, what benefit has the Society secured from its additional outlay of $9,000 and what benefits have accrued to Local Sections and to Society members thereby? In 1937, under the old plan, there were only 5,570 members of the Society on the mailing lists of all the Sections. In 1938, under the new plan, there were $2^1/_2$ times as many, or 14,400 members on the Sections' mailing lists. It will be seen that this service has cost the Society approximately $1 a member not previously interested in the Sections.

Other benefits, however, have accrued. Since the new plan is only in its initial stages, other benefits may reasonably be expected as time goes on. Among the advantages now to be observed, it should be stated that there has been, in general, a stimulation of interest in local activities; that during 1939 the number of meetings has been about 10% greater than in 1938; that probably larger and better-attended meetings have been held; that during the year comparatively few Sections have found it impracticable to hold the minimum of five technical meetings that is required for the maximum assignment from the Society; that there has been greater Section support of Student Chapter activities; and that more Sections have found it possible to issue Section publications and lists of members.

The larger and better-established Sections, at the time the new plan was put into operation, have received less material benefit, if any, from the adoption of the new plan, as compared with the smaller and newer Sections. Although 9 of the 63 Sections have reported that they could see no tangible benefits to themselves from the new plan, the consensus of feeling seems to be that the new plan has been of general benefit to the Society and that it should be continued.

An analysis of Local Section meeting costs on the basis of unit cost per member-attendance shows that these costs vary over a wide range, with a weighted average of about $1.50. The unit cost exceeds the average in only 16 Sections, and only 10 Sections have a cost higher than $2 per member-attendance. A further study of these costs may result in some reasonable standards of expense to guide local operations.

LOCAL SECTION CONFERENCES

Conferences of representatives of Local Sections are scheduled to be held during 1940 at the time and place of the three Society meetings outside of New York—the first on April 16 in Kansas City, Mo.; the second in July in Denver, Colo.; and the third in the fall in Cincinnati, Ohio. These conferences are for the specific purpose of discussing how Local Sections can be made of greatest benefit to the profession, and what duties and functions may properly be turned over to Local Sections. The conferences are open to every member of the Society.

NEW LOCAL SECTIONS AUTHORIZED

Early in 1939 members of the Society in Davenport, Iowa, Rock Island and Moline, Ill., and vicinity, formed themselves into a local organization called the Tri-Cities Civil Engineering Society. A petition received from the members for a Tri-City Local Section was authorized by action of the Board at its January 16 meeting. The new Section, which includes in its area Muscatine, Scott, and Clinton counties in Iowa, and Mercer, Rock Island, Henry, Whiteside, Carroll, and Lee counties in Illinois, is to become a part of District 8.

Sixth Annual Report of Special Committee on Hydraulic Research

As Prepared for the 1940 Annual Meeting of the Society

The purposes of this committee are: (1) to prepare a manual of laboratory practice, including a standard set of letter symbols for hydraulic model work; (2) to sponsor fundamental research projects, emphasizing the physical phenomena involved in certain hydraulic problems; (3) to gather data regarding the comformity of model to prototype behavior; (4) to prepare abstracts of foreign papers dealing with pertinent hydraulic research; and (5) to encourage the preparation of papers on subjects within the purview of the committee's activities. Reports of previous activities have been published in "Civil Engineering" as follows: Vol. 7, No. 3, March 1937, p. 195; Vol. 8, No. 3, March 1938, pp. 194–196; and Vol. 9, No. 2, February 1939, pp. 109–110.

ONE meeting was held during the year at the University of Minnesota on June 8 and 9, 1939. All members and two cooperating members were present. Paul W. Thompson, Assoc. M. Am. Soc. C.E., formerly director of the U.S. Waterways Experiment Station at Vicksburg, having been transferred to a new assignment, Joseph B. Tiffany, Jr., Jun. Am. Soc. C.E., has been appointed to committee membership in his place. Mr. Tiffany has been in responsible charge of model testing at the Experiment Station for some time. At the meeting A. A. Kalinske, research engineer at the University of Iowa, represented both Dr. F. T. Mavis and Dean F. M. Dawson, Members Am. Soc. C.E., cooperating members.

Work on the manual and two of the research projects are nearing completion. The progress of the committee on its various projects is reported under the headings following.

LETTER SYMBOLS FOR USE IN HYDRAULIC LABORATORIES

J. C. Stevens, M. Am. Soc. C.E., reported that Subcommittee No. 2 of the American Standards Association (*Z10b*) had drawn up a tentative list of Symbols for Hydraulics, grouped under four headings: General Symbols, Theoretical Hydraulics, Hydraulic Structures, and Hydraulic Machinery. A separate list of symbols for general use in all branches of engineering consistent with the various sub-lists was set up tentatively. The general principles of symbology as set up by the American Standards Association were read.

FIG. 1. CONFLUENCE CHANNEL SET-UP AT UNIVERSITY OF MINNESOTA, USED FOR SEDIMENTATION STUDIES

The committee decided to adopt a list of symbols for use in the Manual of Hydraulic Laboratory Practice, which would conform to those later issued by the American Standards Association. The dimensional formulas for these symbols were retained as well as the bold-faced **R** for Reynolds number, capital *C* for coefficient, and lower case *d* for depth, general. The L_r-plan adopted last year for representing model scale ratios was reversed; thus, $L_r = Lm/Lp$ = the length ratio of model to prototype.

COMFORMITY OF MODEL TO PROTOTYPE

The results of various comparative measurements on model and prototype structures will soon be ready for publication. Among these are measurements of the Madden Dam, dams of the Tennessee Valley Authority, the Iowa City Dam, projects of the U.S. Engineer Office at Vicksburg, and of river flows in the vicinity of Pittsburgh.

RESEARCH PROJECTS

Project 67-a. "Conversion of Kinetic to Potential Energy in Expanding Conduits," F. T. Mavis, M. Am. Soc. C.E., of Pennsylvania State College, and A. A. Kalinske, University of Iowa. A comprehensive analysis of the flow phenomena as determined by the motion picture studies of velocities in the expanding conduits was made in the form of a progress report by Mr. Kalinske, assisted by J. M. Robertson, Jun. Am. Soc. C.E., research assistant in hydraulics. In addition, a sudden-enlargement section 2.75 to 4.75 in. was studied, and check tests were planned on a 15° expansion made of "Lucite."

The values of the mean velocity, $\overline{U}$, and the mean square turbulent velocity and fluctuations $\overline{v^2}$, $\overline{u^2}$, $\overline{w^2}$, in the three coordinate directions, were determined at different points at various cross-sections of a 3-in. by 5-in. gradual 15° expansion. This permitted the calculation at each section of the total kinetic energy, E_m, due to the mean velocity, and the total energy, E_t, due to the turbulent velocity fluctuations. The energy data plus the pressure variation data along the conduit permit the calculation at each section of the rate of the energy dissipation and the variation of this rate along the conduit. Similar data are being obtained for different discharge rates in the 15° expansion and will also be determined for 8° and 30° expansions and in a sudden expansion. It is believed that the present experimental techniques and the methods of analysis that have been developed will provide fundamental information on the energy transformations occurring in expanding conduits.

Project 67-b. "Traveling Waves on Steep Slopes," H. A. Thomas, M. Am. Soc. C.E., Carnegie Institute of Technology, Pittsburgh, Pa. Numerous motion pictures have been made of waves traveling down the chute of trapezoidal section together with measured data. All are being assembled for preparation of a comprehensive report.

Project 67-c. "Phenomena of Intersecting Streams," M. P. O'Brien, M. Am. Soc. C.E., University of California, Berkeley,

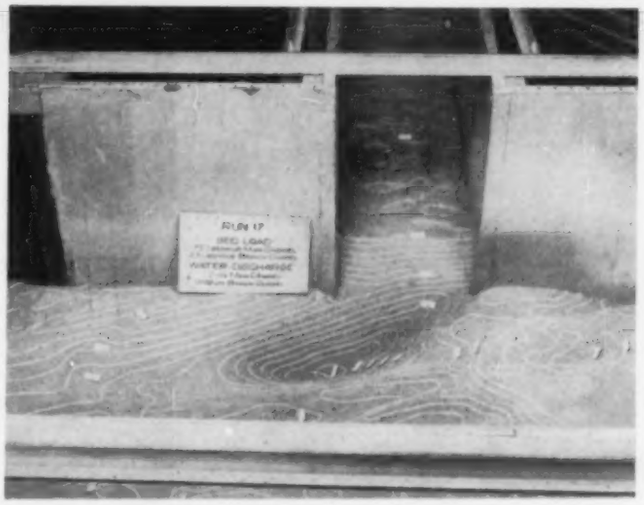


FIG. 2. CONTOURS FOR EQUILIBRIUM CONDITIONS AT CHANNEL CONFLUENCE

Calif. Tests were made on steel pipe intersecting at angles of 30°, 45°, 60°, and 90° together with the complementary angles. During the year the apparatus has been designed and experimental technique perfected. Next, the experiments will be carried out in detail. Three theses have now been completed in connection with this project and are on file with the secretary of this committee: Lt. I. C. Rumsey, "A Report on the Characteristics of Dividing Streams in Open Rectangular Channels"; W. P. Yallalee and E. H. Liedstrand, "Energy Losses in Intersecting Streams"; and R. M. Bickerstaff, Jun. Am. Soc. C.E., "A Qualitative Study of the Intersections of Converging and Diverging Streams." R. L. Stoker and E. H. Taylor, Jun. Am. Soc. C.E., assisted in supervising this work.

Project 67-d. 'Curves in Open Channels," C. A. Mockmore, M. Am. Soc. C.E., Oregon State College, Corvallis, Ore. Laboratory data have been completed and a mathematical analysis made of the streamlines in accordance with certain assumptions regarding boundary conditions and spiral motion in the body of the channel.

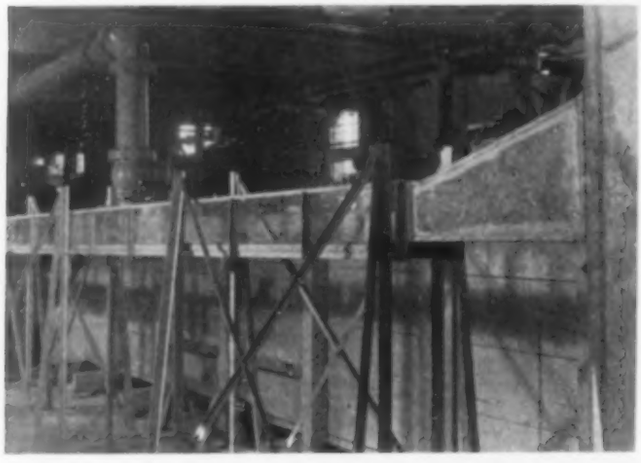


FIG. 3. RECTANGULAR CONDUIT USED IN AIR AND WATER FLOW STUDIES

An undergraduate thesis on the subject by Budd Matlock and Alton Alspaugh, Juniors Am. Soc. C.E., is on file with the secretary of this committee. The final report is now in preparation.

Project 67-e. "Sedimentation at the Confluence of Rivers," L. G. Straub, M. Am. Soc. C.E., University of Minnesota, Minneapolis, Minn. The project on "Sedimentation at the Confluence of Rivers" has been in progress continuously during the past year with several persons actively engaged in the experimental work and construction of apparatus. A new confluence channel was put into operation at the St. Anthony Falls Hydraulics Laboratory (See Fig. 1). The channel system is 3 ft wide, and water is supplied directly from the Mississippi River above the falls. Two types of sand have been used in the investigation—one a bed sediment dredged directly from the upper Mississippi River, and the other a sand of quite uniform grain size approaching that of standard Ottawa sand but slightly finer and more angular. The results of a typical experiment are shown in Fig. 2. Motion pictures have been taken of the apparatus in operation and some of the features of the experiments. The laboratory studies are being supplemented by investigations of several confluences of alluvial streams, and a comparison of some of the outstanding phenomena, particularly in the light of the confluence experiments thus far undertaken, is being made.

Project 67-f. "Air Resistance to Flow of Water," L. G. Straub, M. Am. Soc. C.E., University of Minnesota, Minneapolis, Minn. The project on "Air Resistance to Flow of Water" is designed as fundamental research to determine the mechanics of flow of water in open channels at high velocities. Considerable study has been given to this project by gathering together as much of the fragmentary data as can be found on the subject. A suitable flume on a steep slope has been designed, and construction is now well under way. It has an effective length of approximately 50 ft, is 12 in. wide and 10 in. deep, and is constructed of steel. The water supply is to be taken from the upper pool at St. Anthony Falls on the Mississippi River, where a 50-ft head is available. The apparatus is so designed that various slopes ranging from 0 to 60° with the horizontal can be obtained. Thus far, experimental observations have been made on flow conditions in a large testing channel (9 ft wide and 300 ft long) within the laboratory, where velocities up to 35 ft per sec can be obtained with resulting entrainment of air. In addition, observations have been made on spillways adjoining the laboratory where velocities somewhat higher are obtained on an inclined plane sloping approximately five horizontal to one vertical. Motion pictures are being made in connection with these observations.

Project 67-g. "Simultaneous Flow of Air and Water in a Closed Conduit," F. M. Dawson, M. Am. Soc. C.E., University of Iowa, Iowa City, Iowa. The past year (September 1938 to September 1939) was spent in designing and constructing a rectangular conduit 50 ft long, 8 in. wide, and 7 in. deep, which can be placed at any slope to about 1:10. This conduit has sides of transparent "Lucite" material throughout the entire length (Fig. 3). The experimental work is now beginning and will, in general, consist of the following procedure. For a given slope of the channel, the depth of flow will be varied and the following data obtained for each rate of flow: (1) amount of air dragged along by the flowing water with free air entrance and exit at each end of the conduit; (2) variation of depth of water flow and air pressure along the conduit when the flow of air is prevented at discharge end of conduit; (3) when air is forced through the conduit in the same direction as water flow at a greater mean velocity than the water, the effects on water profile and water surface will be observed; and (4) when air is forced through the conduit counter to the direction of the water flow, the effects on the water surface will be recorded. The four procedures indicated will be repeated for various slopes of the channel.

During the past year work has progressed on a closely allied project, data of which will be available for use in connection with the investigations of the general problems of simultaneous air and liquid flow. This second project is concerned with the hydraulics and pneumatics of vertical drain and overflow pipes flowing partly full. Water and air measurements are being obtained for radial water flow from a circular tank into vertical pipes of 6-in., 4-in., and 2-in. diameter. Several lengths of each diameter will be tested. The experiments also include methods for obtaining uniform entrance conditions. Mr. Kalinske has collaborated in this study, and A. M. McLeod assisted in the design of the apparatus.

Project 67-h. "Field Studies of Entrainment of Air on Spillways and in Chutes," J. E. Warnock, Assoc. M. Am. Soc. C.E., U.S. Bureau of Reclamation, Denver, Colo. The primary objectives of this investigation are to determine: (1) the air-content in the flow and its relation to other flow factors; (2) the mechanics by which air enters the flow; and (3) the relationship of the factors retarding the velocity of flow in the channel.

The progress to date may be summarized as follows: (1) An extensive study has been made of domestic and foreign literature, and certain foreign articles were translated; (2) attempts were made to develop a method of measuring high velocities; (3) field tests were made on an existing structure to verify assumptions

FIG. 4. ENTRAINMENT OF AIR BY THE OVERFALLING SHEET OF WATER ON THE BLACK CANYON SPILLWAY

based on the collected information; and (4) analyses of all data have been made and some conclusions drawn. In regard to (1) the extent of the material available is very limited. Several theories have been advanced, and data to substantiate some of them are given. The result of (2) is a modification of the salt-velocity method of measuring discharge in closed conduits adaptable to obtaining velocities in open channels with high gradients. The field tests (3) were conducted on a high-head wasteway on the Kittitas Division of the Yakima Project of the Bureau of Reclamation. In this structure, the total fall is 340 ft, part of which is on a slope of 33° 10′. Measurements were made for a range of discharge from 90 to 1,000 cu ft per sec with a variation in the hydraulic radii from 0.5 to 1.7 ft. Additional observations to further develop the equipment were made on an overfall dam. Analyses (4) have resulted in tentative formulas based on a rational mathematical approach and substantiated by data obtained from the field tests or gained from the literature. It has been found that under certain conditions water flowing at high velocities in open channels entrains air. This entrained air amounts to as much as 50% of the total flow by volume. The entrainment of air or some factor contributing to the entrainment of air appears to reduce the velocity of the stream below that calculated by present methods. Further studies are necessary to substantiate the present findings. Some information in regard to the water-air mixing has been obtained through observation of flow in numerous field structures and by means of high-speed motion picture photography.

The entrainment of air by the overfalling sheet of water on the Black Canyon Spillway is shown in Fig. 4. Future work will consist of possible measurements on some high overfall dam. This may not be possible until either the Grand Coulee or Shasta Dam, where test installations have been incorporated, has been completed. The acquisition of an ultra-high-speed motion picture camera is being considered. A study of the surface of flow exposed to the air, made by means of this camera, should throw some light on the mechanics of the air-water mixing process.

The committee looks for publication of part of the partially completed projects before starting additional projects.

MANUAL OF HYDRAULIC LABORATORY PRACTICE

The first draft of the manual has been completed, and the arrangement and material were discussed throughly with a view to manner of publication. It was decided to issue the manual in mimeograph or offset printing form as soon as possible. When issued it will be sent to interested persons for constructive criticism. It is hoped that this draft will be available early in 1940.

TRANSLATIONS

Nine translations of foreign papers are in process of preparation for publication under the immediate supervision of D. P. Barnes, Assoc. M. Am. Soc. C.E., California Institute of Technology, Pasadena, Calif., cooperating member.

Respectfully submitted,

SPECIAL COMMITTEE ON HYDRAULIC RESEARCH
J. C. STEVENS, *Chairman;* CHILTON A. WRIGHT, *Sec'y*

Boundaries of Districts and Zones for 1940

UPON recommendation of the Board's Committee on Districts and Zones, a few changes in boundaries were adopted at the January 16 meeting of the Board of Direction. In all, four revisions were adopted, providing:

"1. That the line between Districts 4 and 6 in Pennsylvania be changed from longitude 78° West to the East lines of Cameron and Clearfield Counties, the North line of Blair and Huntingdon and the East Lines of Huntingdon and Fulton Counties.

"2. That the line between Districts 3 and 4 in Pennsylvania be changed from longitude 78° West to the East line at McKean County.

"3. That the line between Zones I and II in Pennsylvania now following longitude 78° West be changed to follow the East line of McKean County.

"4. That Muscatine, Scott and Clinton Counties in Iowa be added to District 8 and subtracted from District 16."

The new boundaries for all the Districts and Zones, including those now revised, are to become effective for election purposes during 1940. This action of the Board complies with the Constitutional provision, Article VII, Section 1, that the various boundaries shall be announced to the membership not later than April 1.

Irma Gerow, Staff Member, Dies

MISS IRMA GEROW, for almost 20 years a member of the staff at Society headquarters, died suddenly on Thursday, February 15.

For several years Miss Gerow had served in the capacity of librarian and general research worker; she was also in responsible charge of the Year Book and of compiling the annual index for CIVIL ENGINEERING and TRANSACTIONS. Many members of the Society will recall her as sharing the information-booth duties with Miss Louise Webb (now retired) at the Annual Meetings. In earlier years she had also served on the publications staff, as assistant style-editor of PROCEEDINGS.

Her familiarity with the work and traditions of the Society made her a valuable member of the headquarters staff. As research worker she efficiently handled the widest variety of requests for information from all parts of the world. One member, on learning of her death, wrote the Society of an occasion on which she had been assigned to assist him in a library search. It would have taken him many days, he wrote, to do "what she did in a few hours," and he added that later, at the Public Library, six assistants spent from two to five hours each without uncovering a single reference she had not found.

Miss Gerow came to the Society first in 1916, and had been in its employ continuously since 1928, for a total of almost 20 years of service. She had also spent 4 years with the Engineering Societies Library.

She was 52 years of age. Surviving her are two sisters, Aline and Edith, with whom she lived in Jersey City.

Twelve Student Chapters Commended for Year's Work

EACH YEAR the Society's Committee on Student Chapters recommends to the Board of Direction the twelve Chapters considered to have done particularly meritorious work during the preceding year, judged by the reports submitted. Accepting this recommendation, the Board, at its January 16 meeting, voted that a "letter of commendation" for the success during the year 1938–1939 be forwarded in the name of the President to each of the following Student Chapters of the Society:

NORTHERN DISTRICT	SOUTHERN DISTRICT
Carnegie Institute of Technology	Johns Hopkins University
University of Illinois	Tulane University
Pennsylvania State College	Virginia Military Institute
EASTERN DISTRICT	**WESTERN DISTRICT**
Newark College of Engineering	University of Arizona
New York University	University of California
Rhode Island State College	University of Kansas

It is gratifying to note that for Tulane University this is the fifth consecutive award—it has received one each year since this notation of merit was adopted. Carnegie Institute of Technology, the University of Illinois, and Virginia Military Institute have each won the award four times; Newark College of Engineering, three times; and Johns Hopkins University and New York University, twice each.

For administrative purposes the 120 Student Chapters of the Society were divided into four districts, of which the Northern comprised 30 Chapters, the Eastern, 30 Chapters; the Southern, 29 Chapters; and the Western, 31 Chapters. Three awards are authorized for each district, and it will be seen, therefore, that the awards go very nearly to one in every ten Chapters. This is a gage of the degree of honor represented in this recognition of outstanding merit. Congratulations are in order to each of these 12 Chapters.

American Engineering Council

The Washington Embassy for Engineers, the National Representative of a Large Number of National, State, and Local Engineering Societies in 40 States

A.E.C. Changes Quarters

EFFECTIVE February 15, American Engineering Council shifted its offices in Washington from the old quarters which it had occupied since 1922 to a new location at 919 Seventeenth Street, N.W., where it will occupy a building jointly with the American Forestry Association and immediately adjoining the Army and Navy Club.

While the primary motive for the move was the expanding needs of the American Council on Education, which had been sharing the building at 744 Jackson Place, A.E.C. will itself realize a number of benefits that will more than offset the trouble of moving. The new offices are fully as convenient, being located only a block distant from the old, and will provide facilities better adapted to the needs of Council, which requires much storage space for the valuable records accumulated during the past twenty years. These are now more readily accessible. In addition, there will be a distinct saving in rental charges, making it possible to devote a larger proportion of the annual budget to productive activities.

Engineers and others interested in Council's activities are cordially invited to visit the new offices whenever they are in Washington.

Research Cuts Costs of Slum Clearance

Collaboration between the National Bureau of Standards and the U.S. Housing Authority, which is the agency administering federal loans and subsidies to rehabilitate slum areas, has resulted in a considerable saving in the cost of constructing low-rent housing projects in many cities.

The principal field of research activity concerns the selection of materials and the improvement of construction methods. Typical projects involve the study of masonry mortars and concrete floor slabs, roofing, and heating equipment. Since USHA loans are amortized over a 60-year period, an important factor in the research work is the proper balance between capital costs and maintenance expense. During the calendar year 1939 direct savings of over $350,000 have been attributed to research results, and this amount will increase during the current year as construction volume increases.

Other fields of collaboration between the two agencies include recommendations for the modernization and rationalization of municipal building codes to permit more economic design, utilizing the demonstrated capacities of modern materials, and the standardization of specifications. Savings of $280,000 in 1940 are anticipated from the simple process of recommending the use of seven standard sizes of wood double-hung windows in all projects, in place of the 76 different types and sizes called for in 18 projects recently reviewed by USHA's Technical Division. Steel casements will also be standardized.

Savings in interest during construction by the sale of short-term bonds to private investors, an idea recently tried out, is a success, according to recent announcement. The first offering of $50,000,000 on November 8 was sold at an interest rate of slightly under 0.6%; a second offering of $35,000,000 was sold late in January at a net rate of approximately 0.45%. Local housing authorities will save the difference between these low rates and the 2¾% to 3¼% rate that must legally be paid the government by depending upon private financing during the period of construction, which ranges up to 18 months on the larger projects.

FHA Plans to Rebuild Blighted Areas

Regulations governing the extension of mortgage insurance by the Federal Housing Administration to cover private loans by banks, insurance companies, and other large financial institutions for the purpose of rehabilitating substantial areas in the so-called "blighted" areas of urban districts will shortly be issued.

Such projects fall under that section of the National Housing Act covering large-scale rental mortages. Eligibility requirements contemplate new construction equivalent to at least 50% of the mortgage, the balance to be expended upon modernization of existing structures. A project must include at least 20 dwelling units so located in relation to one another as to result in a distinct improvement in housing standards and conditions in the neighborhood. Maximum interest rates are set at 4½% for mortages under $100,000; 4% for larger amounts.

In the single-dwelling field FHA will, during the coming construction season, direct special emphasis upon the stimulation of low-cost homes that can be paid for at approximately $25 per month or less, and thus be available to families with annual incomes ranging from $1,000 to $2,000.

Reclamation Program Proposed

Responding to a request by Senator Carl Hayden of Arizona, Secretary of the Interior Harold L. Ickes recently declared that adequately to meet present demands for irrigated land the Bureau of Reclamation could well spend from $50,000,000 to $60,000,000 during each of the coming five fiscal years in the construction of regular reclamation projects of which the costs are fully reimbursable by those benefiting, as well as non-reimbursable expenditures of from $5,000,000 to $7,000,000 per year to supplement additional repayable annual amounts of approximately $5,000,000 in the recently inaugurated program for the construction of special projects in the Great Plains area.

Senator Hayden's request was prompted by the fact that certain parts of the Great Plains area are now suffering from the most severe autumn drought in recorded history. Unless conditions change radically, this will mean during the coming summer a marked resumption in the tide of emigation from this area that has already witnessed the departure of an estimated 100,000 farm families. Pointing out that during 1939 relief expenditures in the 17 states affected by the drought by the WPA alone amounted to over $359,000,000, Senator Hayden suggested the possibility that larger expenditures for reclamation work in this area might result in a material curtailment of the future relief load.

California Urged to Form Public Power Agencies

In answer to requests by California officials for information on how to cooperate in the future operation of the Central Valley power and irrigation project, now under construction, Secretary of the Interior Harold L. Ickes has written a letter to Governor Olson pointing out that the law requires the Bureau of Reclamation, in marketing power from its projects, to give preference to public agencies. It is also usual policy to turn over to responsible local organizations the operation and maintenance of those portions of projects which serve them with water.

The Secretary suggested, therefore, that state officials consider means to promote the formation of suitable local organizations for these purposes, particularly for the distribution of electric power. He warned that the preferential claim upon power provided by law can only be recognized to the extent that markets for its consumption are ready, and suggested the formation of a number of additional local power distributing districts within economical transmission distance of the project. These could be served through transmission facilities operated by the state, or an agency of the state.

TNEC States Plans

Having given recent consideration to the characteristics of cartels and completed hearings on steel and life insurance, the Temporary National Economic Committee through its chairman, Senator Joseph C. O'Mahoney of Wyoming, has announced its plans for winding up the inquiry, which began late in 1938. Additional hearings will be held on at least three subjects: interstate trade barriers; the impact of technological development upon employment; and, finally, an economic free-for-all at which the committee will listen to witnesses desiring to present ideas for the solution of economic problems.

In its investigation of technical change the committee is expected to examine a number of fields of business, and particularly the machine tool industry. Much basic material is available as the result of a comprehensive study of this question that has been under way for several years under the sponsorship of the research division of the Works Projects Administration. In planning the final sessions, the committee recognizes that it will be impossible to hear all witnesses that will volunteer, but hopes to receive applications for time from "responsible students, and particularly from institutions and groups which have utilized their resources for special studies."

CCC Quotas Filled

With approximately 176,000 applicants applying for junior enrolment in the Civilian Conservation Corps, that agency had no

difficulty in filling 63,903 vacancies in this classification that existed as of January 1, 1940. Completion of the replacement program left some 105,000 applicants still on the list. In addition to the junior enrolees, 3,351 war veterans were accepted to fill vacancies in this classification.

Washington, D.C.
February 7, 1940

By-Laws Revised As to Article IV —"Committees"

REVISION of the By-Laws to provide for changes in the set-up of committees and in the functioning of the Committee on Technical Procedure was formally initiated at the October meeting of the Board of Direction, when notice of such amendment was given. Final action was taken at the January 15, 1940, meeting.

As adopted by the Board, Section 1 of Article IV is amended by the addition to the list of Standing Committees of the Board of "A Committee on Division Activities." This new committee is described by the insertion of a new Section 8 in Article IV, with the following wording:

"8. *The Committee on Division Activities* shall consist of the Senior Vice-President of the Society who shall be the Chairman of the Committee; the Vice-President of the Society who will be the Senior Vice-President in his second year in office; the Chairman of the Committee on Publications; and, at the discretion of the Board, not more than two other Board Members. The Committee shall review the work of the Divisions and make recommendations to the Board in respect to their appropriations. It shall keep the officers of the Divisions informed of such problems facing the Board as may affect their technical activities or as may affect the publication of products of the Divisions. It shall encourage cooperation among the Divisions, and between the Divisions and the Board. It shall review, report, and make recommendations to the Board upon the activities and budget requests, of the Divisions."

The remaining sections are to be numbered correspondingly; that is, the old Section 8 now becomes Section 9, and so forth.

In Section 10, which now becomes Section 11, paragraph (*b*) is to be struck out and in its place the following is to be substituted:

"(*b*) *The Committee on Technical Procedure* shall consist of the Chairmen of the Executive Committees of the Technical and Functional Divisions of the Society, who shall serve for their full terms, and the members of the Committee on Division Activities. The Senior Vice-President of the Society shall be the Chairman of the Committee.

"It is the function of the Committee on Technical Procedure to coordinate all of the activities of the Divisions and to make recommendations to the Board regarding their activities. The Committee shall meet once each year, at the time and place of a Board Meeting."

These amendments, effective immediately, will be incorporated in the printed By-Laws as they will appear in the 1940 Year Book, to be distributed as part of the April PROCEEDINGS.

News of Local Sections

Scheduled Meetings

CLEVELAND SECTION—Luncheon meeting at the Guildhall on March 5, at 12:15 p.m.

COLORADO SECTION—Dinner meeting at the University Club on March 11, at 6:30 p.m.

DAYTON SECTION—Luncheon meeting at the Engineers Club on March 18, at 12:15 p.m.

DISTRICT OF COLUMBIA SECTION—Regular meeting at the Cosmos Club in Washington on March 15, at 8:15 p.m.

GEORGIA SECTION—Luncheon meeting at the Atlantan Hotel on March 11, at 12:30 p.m.

IOWA SECTION—Talk at Iowa State College on March 7, at 7:30 p.m.

ITHACA SECTION—Dinner meeting in Willard Straight Hall, Ithaca, on March 8, at 6:30 p.m.

LOS ANGELES SECTION—Dinner meeting at the University Club on March 13, at 6:30 p.m.

METROPOLITAN SECTION—Technical meeting at the Engineering Societies Building in New York on March 20, at 8 p.m.

PHILADELPHIA SECTION—Meeting at the Engineers Club on March 12, at 7:30 p.m. (Meeting preceded by a good-fellowship dinner at 6 p.m.)

PITTSBURGH SECTION—Technical meeting at the William Penn Hotel on March 5, at 8 p.m.

ST. LOUIS SECTION—Tentative plans for a meeting on March 25.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:10 p.m.

SPOKANE SECTION—Luncheon meeting at the Davenport Hotel on March 8, at 12 noon.

SYRACUSE SECTION—Dinner meeting at the Onondaga Hotel on March 11, at 6:30 p.m.

TENNESSEE VALLEY SECTION—Dinner meeting of the Knoxville Sub-Section at the S. and W. Cafeteria on March 5, at 6 p.m.

WISCONSIN SECTION—The Section will participate in the 1940 Engineering Conference to be held at the Pfister Hotel in Milwaukee, March 13 to 15, inclusive.

Recent Activities

ARIZONA SECTION—*January 27:* The following speakers were heard at this special luncheon and afternoon session: Charles T. Leeds, Director of the Society; Raymond A. Hill, consulting engineer of Los Angeles; Vic H. Housholder, district sales manager for the Western Metal Manufacturing Company, Phoenix; James Girand, city engineer of Phoenix; John Girand, resident engineer for the PWA; and Clyde Myers, director of engineering at Phoenix Junior College. Both Colonel Leeds and Mr. Hill discussed the Society's Committee on Professional Objectives.

BUFFALO SECTION—*December 12:* At this dinner meeting the speakers were Charles E. Wuerpel, engineer in charge of the Central Concrete Laboratory of the U.S. Engineer Department at West Point, N.Y., who discussed good and bad concrete construction; and Charles Waters, of the Erie County (New York) Highway Department, who described the work of the department. The annual election of officers resulted as follows: Nelson Stone, president; Wallace Carr, vice-president; Robert Davenport, secretary; and Norman Herthe, treasurer. *January 9:* Following a luncheon, Dean Austin Pardue, rector of St. Paul's Episcopal Church, spoke on his experiences in England during the past summer when preparations for war were being made.

CENTRAL ILLINOIS SECTION—*Springfield, December 5:* The regular annual dinner was followed by the election of officers for 1940. These are C. M. Hathaway, president; R. P. Hoelscher, first vice-president; W. H. Wisely, second vice-president; and H. P. Evans, secretary-treasurer. W. W. DeBerard, Director of the Society, then presented certificates of life membership to two members of the Section—Frank Dudley Holbrook and Samuel Moorhead Russell. A talk entitled "Research in the World of Tomorrow" concluded the program. This was given by Ernest L. Foss, director of General Motors' preview of progress at the New York World's Fair.

CINCINNATI SECTION—*January 18:* Joint meeting with the Engineers' Club of Cincinnati. The principal speaker was J. W. Bradner, Jr., manager of the Norris Properties of the Tennessee Valley Authority, who presented a paper on the subject, "An Engineer Looks at the TVA."

CLEVELAND SECTION—*January 15:* On this occasion the Section celebrated its twenty-fifth annual meeting. The guest speaker was Frank T. Sheets, president of the Portland Cement Association, whose subject was "How Can We Prepare for the Highway Job Ahead." It was announced during the session that a certificate of life membership had been awarded to Homer J. Gault—the only

member of the Section to be thus honored in 1939. Election of officers for 1940 concluded the meeting, the results being as follows: John H. Anderson, president; George W. Hamlin, vice-president; and G. Brooks Earnest, secretary-treasurer.

COLORADO SECTION—*Denver, January 15:* A musical program was presented during the dinner that preceded the regular meeting. Later there was a talk on "Tourism and What It Means to Colorado." This was given by J. H. Thompson, national director of the Conoco Travel Bureau.

DAYTON SECTION—*January 15:* Following a business session, F. H. Waring discussed the role of the public health engineer. Mr. Waring is chief engineer of the Ohio State Department of Health.

DULUTH SECTION: The Duluth Section reports that monthly meetings were held during the summer, fall, and early winter. The list of speakers appearing on these occasions includes Harry Weinberg, city attorney for Duluth; John H. Darling, retired engineer of Duluth; Gordon H. Butler, Sr., president and treasurer of the Polaris Concrete Products Company; C. E. Stahl, local PWA engineer; C. A. Graves, director of the Minnesota Testing Laboratory; Jarl Syverston, civil engineer of New Zealand; and George W. Deibler, assistant engineer for the St. Louis County (Minnesota) Highway Department. At the January meeting the following officers were elected: Frank Hutchinson, president; Roland Buck, first vice-president; C. K. Clickener, second vice-president; William E. Hawley, secretary; and John Carson, treasurer.

GEORGIA SECTION—*Atlanta, January 8:* A talk on "Railroad Problems of Today" was given by R. S. Young, chief engineer of the Atlanta and West Point Railroad.

ITHACA SECTION—*January 16:* Prof. Carl Crandall, of the civil engineering school at Cornell University, gave an illustrated talk on New York State parks, and Prof. E. W. Schoder presented a motion picture entitled "Football Thrills of 1939."

KENTUCKY SECTION—*Lexington, January 26:* Joint meeting with the Kentucky Society of Professional Engineers. A luncheon followed the afternoon session, at which the following speakers were heard: Lt. A. H. Near, superintendent of Bowman Field, Louisville, Ky.; George Armstrong, general superintendent of the Louisville Gas and Electric Company; Frank J. Crandell, civil engineer and construction supervisor for the Liberty Mutual Insurance Company; and J. H. Graham, dean of the college of engineering at the University of Kentucky. The evening session took the form of a dinner meeting, with Thomas Underwood, editor of the *Lexington Herald*, acting as toastmaster. T. Ward Havely, mayor of Lexington, gave an address of welcome, and Prof. E. F. Farquhar, of the University of Kentucky, spoke on the role of the United States in world affairs.

LEHIGH VALLEY SECTION: The Section announces that its officers for 1940 are as follows: L. P. Grossart, president; E. F. Ball and C. D. Jensen, vice-presidents; and M. O. Fuller, secretary-treasurer.

LOS ANGELES SECTION—*January 10:* The oil industry was the subject of discussion at this meeting, the principal speakers being Howard C. Pyle and Earle W. Cord, both of the staff of the Union Oil Company. Mr. Pyle's subject was "Modern Petroleum Production Methods," while the latter discussed petroleum refining.

LOUISIANA SECTION—*New Orleans, January 13:* Joint meeting with the Louisiana Engineering Society on the occasion of their annual meeting. Illustrated papers were presented by A. J. Boase, manager of the Structural Bureau of the Portland Cement Association, whose subject was "European Practice in Reinforced Concrete Structures"; and W. F. Tompkins, district engineer for the 2d New Orleans District of the U.S. Engineer Office, who spoke on "The Wax Lake Outlet and the Charenton Drainage and Navigation Canal."

MARYLAND SECTION—*Baltimore, January 23:* This session was devoted largely to discussion of the report of the Section's Committee on Professional Objectives. The guest of honor and principal speaker was Walter E. Jessup, Field Secretary of the Society, who discussed news from Society Headquarters. *Junior Association, November 14:* "The Defense of the Panama Canal" was the subject of a talk given by Captain Forney, of Johns Hopkins University.

METROPOLITAN SECTION—*January 10:* A talk on "Engineering Features of Modern Radio" was given by O. B. Hanson, chief engineer of the National Broadcasting Company. Mr. Hanson was assisted by members of his staff who gave practical demonstrations of the various instruments and devices under discussion.

MICHIGAN SECTION—*Ann Arbor, January 19:* Joint dinner meeting with the University of Michigan Student Chapter. Henry E. Riggs, Past-President of the Society, gave a short talk, in which he stressed the need of a "united front" of all civil engineers. He was followed by Director Ayres, who gave a report on the Annual Meeting. The principal speaker of the evening was George Thompson, city engineer of Detroit, who discussed the subject, "The Engineer and the Budget."

MID-MISSOURI SECTION—*Jefferson City, December 15:* A business meeting, during which the annual election of officers took place, preceded dinner. The officers are Henry C. Beckman, president; W. Scott Johnson, first vice-president; H. W. Wood, second vice-president; Raymond W. Brooks, secretary-treasurer; and Harrison D. Comins, Junior director. Following dinner William Anderson, director of the Missouri State Planning Board, was introduced and spoke on the activities of the Board.

NASHVILLE SECTION—*February 6:* Following dinner Marret Wheeler, architect, discussed special design and construction features of the new Vanderbilt University library. G. T. Fenn then described the air conditioning and heating arrangements for the structure.

NEBRASKA SECTION—*Lincoln, January 10:* Joint dinner meeting with the University of Nebraska Student Chapter. Kirk Florance, president of the Chapter, gave an address of welcome, and J. C. Detweiler, president of the Section, responded for the members. Talks were then given by T. A. Leisen, of Omaha, who reminisced concerning his engineering experiences, and John E. Curtis, district manager of the Iowa-Nebraska Light and Power Company, whose subject was "My Observations of Engineers in Action." Following the formal program, officers were elected for 1940. These are Roy M. Green, president; R. E. Edgecomb, vice-president; and C. E. Spellman, secretary-treasurer.

NORTH CAROLINA SECTION—*Raleigh, January 27:* Two speakers—W. G. Geile, vice-president of the Section and professor of structural engineering at North Carolina State College, and C. W. Mengel, director of public works and service for Greensboro, N.C. —had been scheduled for this technical session. However, Professor Geile was stricken with a heart attack and died shortly after the meeting got under way, and the group adjourned immediately out of respect to him. The papers will be printed in full in the *North Carolina Civil Engineer*.

NORTHWESTERN SECTION—*St. Paul, February 5:* The feature of the occasion was a talk by John D. Akerman, professor of aeronautical engineering at the University of Minnesota, whose subject was "Modern Aircraft Design." Professor Akerman described the problems involved in developing 1,000 hp in a 2 by 2 by 4-ft space and gave a résumé of the history of flying.

OREGON SECTION—*Portland, January 5:* Following the annual dinner meeting, certificates of life membership were presented to John H. Lewis and William Gerris Brown. The speaker was Marshall Dana, editor of *The Oregon Journal*, who addressed the gathering on the "Relation of Education to Democracy." Election of officers for 1940 concluded the meeting. These are B. M. Howard, president; Carl Green, first vice-president; C. I. Grimm, second vice-president; H. H. Leupold, secretary; R. E. Cushman, treasurer; and F. M. Warren, Jr., assistant secretary.

PANAMA SECTION—*Panama City, January 15:* The guest of honor and speaker was N. M. Fenneman, physiographer and geologist of Columbia University. Professor Fenneman lectured on the subject of "Present-Day Problems of Geography."

PHILADELPHIA SECTION—*January 9:* An unusually large attendance of 250 gathered on this occasion to hear the Pennsylvania Turnpike explained and discussed. Those participating in the symposium were Samuel W. Marshall, chief engineer of the Turnpike Commission, who discussed the history, general program, policies, and economics of the turnpike; Frederick S. Poorman, assistant chief engineer, who spoke on specifications and construction methods used on the project; Charles M. Noble, special highway engineer, who described special features; Richard M. Merriman, chief tunnel engineer, who discussed the turnpike tunnels;

and Hubert K. Bishop, chief of the Division of Construction of the Public Roads Administration, who also commented on the turnpike tunnels and then showed slides of various tunnels in the West. A general discussion followed. Col. C. E. Myers was in charge of arrangements.

PROVIDENCE SECTION—*January 15:* An illustrated lecture entitled "Great Dams of the West" was presented by W. C. Huntington, professor of civil engineering at the University of Illinois. *January 23:* The Section entertained J. P. Hogan, newly elected President of the Society, and Secretary Seabury at a special dinner meeting.

ROCHESTER SECTION: The Section announces that its officers for 1940 are as follows: Norman H. Davidson, president; Arthur L. Vedder, first vice-president; Albert R. Reilly, second vice-president; and Raymond C. Schwind, secretary-treasurer.

SACRAMENTO SECTION—*January 2, 9, 23, and 30:* The usual weekly luncheon meetings took place on these dates, the speakers being Charles E. Andrew, principal consulting engineer for the Washington Toll Bridge Authority, and Fred J. Grumm, engineer of surveys and plans for the California State Division of Highways. On the 9th the annual election of officers was held, with the following results: Daniel R. Cate, president; Andrew J. Meehan, second vice-president; and Theodore Neuman, secretary. Edwin A. Fairbairn was automatically advanced to the office of first vice-president. The feature of the fourth of these meetings was the presentation by the California Redwood Association of a new sound film showing modern methods of logging and manufacturing redwood. *January 12 and 16:* On the 12th, the installation of new officers took place at the annual dinner and dance. On the evening of the 16th, A. G. Mott showed four reels of colored motion pictures he had made on a world cruise by commercial air lines. *Junior Forum, January 10:* Ray A. Murray, of the Portland Cement Association, gave an illustrated lecture on "The Fundamentals of Concrete Design and Control of Concrete Mixes." A discussion on how to improve the Forum concluded the meeting.

ST. LOUIS SECTION—*January 22:* During luncheon Col. F. G. Jonah discussed some of the high lights of the Annual Meeting. Then Prof. A. W. Brust, of Washington University, gave a talk on the subject of "Changes in the Quantity, Quality, and Uses of Timber."

SAN DIEGO SECTION—*January 25:* The speakers on this occasion were J. D. Sherry, major, U.S. Army Reserve Corps, and Ray Footite, of the Ryan Aircraft Company. Major Sherry spoke on national defense, while Mr. Footite's subject was "Modern Design Trends in Airplanes." The Section announces that its officers for 1940 are C. B. Sadler, president; I. C. Hess, vice-president; and C. W. Capwell, secretary-treasurer.

SEATTLE SECTION—*January 29:* Officers for the coming year were elected as follows: Cotton M. Howard, president; Richard G. Tyler, vice-president; and Fred H. Rhodes, Jr., secretary-treasurer. Joseph Jacobs, Vice-President of the Society, was present and reported on recent action taken by the Board.

SOUTH CAROLINA SECTION—*Columbia, January 5:* Annual meeting held jointly with the South Carolina Society of Engineers. The speakers scheduled for this all-day session were C. A. Hogentogler, senior highway engineer for the Public Roads Administration, Washington, D.C.; Roy W. Crum, director of the Highway Research Board, Washington, D.C.; L. F. Harza, consulting engineer on the Santee-Cooper Project, Charleston, S.C.; W. J. Valentine, assistant development engineer for the South Carolina Public Service Authority, Charleston, S.C.; Harry T. Poe, Public Works Administration, Charleston, S.C.; and Dr. W. H. Frazer, Charlotte, N.C. During the business session E. L. Clarke was elected president for 1940. E. R. Cary will continue as vice-president, and Albert E. Johnson as secretary-treasurer for another year.

SPOKANE SECTION—*January 12:* This regular luncheon meeting was devoted to a discussion of salary schedules, the Section going on record as not in favor of a single schedule for the country at large. The Section has announced that its new officers for 1940 are E. L. Haines, president; I. N. Carter, first vice-president; R. D. Gladding, second vice-president; and W. S. Mortimer, secretary-treasurer.

TACOMA SECTION—*January 13:* Following a dinner and the presentation of a musical program, the installation of officers for 1940 took place. These are Bertram P. Thomas, president; Fred C. Dunham, vice-president; and Wells H. Ashley, secretary-treasurer. The remainder of the evening was devoted to a magician's performance, dancing, and bridge.

TENNESSEE VALLEY SECTION—*Chattanooga Sub-Section, January 16:* Several committee reports were heard, and C. B. Coe gave a résumé of a recent meeting of the Section's board of directors. The speaker of the evening was A. D. Spottswood, head of the Transportation and Industrial Economics Division of the Tennessee Valley Authority, who discussed "Freight Rates in the South."

TOLEDO SECTION—*December 14:* During the annual business meeting W. H. Hasselbach was elected president, and H. A. Stepleton, vice-president. R. A. Nyquist will continue as vice-president for another year, and R. W. Abbott as secretary-treasurer. Brief talks on the Society were given by Herbert F. Friege and Prof. R. H. Sherlock. The main speaker—H. M. Miller, who is retained in an advisory capacity in the Ordnance Division of the army—then gave a talk on the subject of "Our Part in the Present World Problem."

UTAH SECTION—*February 2:* In addition to considerable business discussion, there was a talk on "Developments in Mechanized Military Equipment Since the World War." This was given by Maj. Geoffrey B. Bunting.

WEST VIRGINIA SECTION: The Section reports that the following new officers have been elected: W. S. Downs, president; T. A. Bloecher and B. H. Simpson, vice-presidents; and A. E. McCaskey, secretary-treasurer.

WISCONSIN SECTION—*Milwaukee, December 13:* This session was devoted largely to the discussion of business matters. The annual election of officers held at this time resulted as follows: C. A. R. Distelhorst, president; C. A. Willson, first vice-president; B. E. Brevik, second vice-president; and Lloyd D. Knapp, secretary-treasurer. The meeting concluded with brief talks by J. P. Gebhart, retiring president, and Mr. Distelhorst. *January 26:* Ladies were guests of the members on this occasion. Following dinner H. J. Lehwald entertained with a series of card tricks and other sleight-of-hand performances. Later W. D. Kline, of the Milwaukee Public Museum, gave an illustrated talk entitled "Following the Lincoln Trail," in which he covered the early life of Lincoln in Kentucky, Indiana, and Illinois.

WYOMING SECTION—*Laramie, January 25:* Much of the meeting was devoted to discussion of engineers' salary schedules. The following officers will serve for 1940: C. F. Seifried, president; A. J. McGaw, vice-president; and H. T. Person, secretary-treasurer. W. W. Flora will be assistant to the president, and Alan W. Holliday assistant to the secretary.

Student Chapter Notes

BROWN UNIVERSITY—*January 15:* Following a business discussion, W. F. Allen, Jr., a member of the Chapter, presented a paper entitled "Revolution 1776," in which he discussed methods of writing history. *January 23:* A number of the members of the Chapter were entertained by the Providence Section on the occasion of its special dinner for President Hogan and Secretary Seabury.

NEWARK COLLEGE OF ENGINEERING—*February 6:* An address on the organization activities of the army engineers was given by Charles B. Ferris, who also discussed the Regular Army, the National Guard, and the U.S. Reserve Corps. Motion pictures depicting the duties of the combat engineer concluded the meeting.

RHODE ISLAND STATE COLLEGE—*January 15:* The Skagit River power development was the subject of discussion at this session. Following the showing of motion pictures of the development the guest speaker, Whitney C. Huntington, head of the department of civil engineering at the University of Illinois, discussed his observations made on a tour of the development. *January 16:* Fred Waterman, director of the Rhode Island Department of Public Works, spoke on "Recent Developments in Highway Construction in Rhode Island."

ITEMS OF INTEREST

About Engineers and Engineering

CIVIL ENGINEERING for April

"THE BEST equipped, most up-to-date airport in the country"—La Guardia Field, in New York City—is to be featured in next month's CIVIL ENGINEERING in an article by Col. Brehon B. Somervell. From a construction standpoint, the most striking feature of the project was the earthwork; with approximately 60% of the field on made ground, some 17,000,000 cu yd of fill was required to complete the development. But other matters such as function and design of buildings and service systems are of equal interest, and all will be covered in Colonel Somervell's contribution.

Of particular interest to structural engineers will be F. H. Frankland's review of European developments in research on impact and fatigue in structures. Hydrologists will find much of value in Charles V. Theis' discussion of the source of water derived from wells, and soils mechanicians will welcome the detailed description by Profs. F. B. Farquharson and R. G. Hennes of the technique of using gelatin for the photoelastic analysis of stress in earth masses.

In the field of city planning will be a paper by Jacob L. Crane, Jr., on "Public Housing and City Rebuilding." Ralph Budd will conclude his series on railroad crossings of the Continental Divide. And "Operations and Plans of the Port Authority," by Glenn S. Reeves, will add a second installment to the series of articles on the Port of New York.

Also included in the April issue will be those by Miles S. Kersten and William R. Bandy, previously tentatively announced for March. They are, respectively, "Testing Visibility of Highway Signs" and "In Search of the North Boundary of Wyoming."

Highway Research Board to Admit Associates

THE EXECUTIVE Committee of the Highway Research Board, National Research Council, announces that recent changes in the by-laws of the Board provide for the affiliation of Associates with the Board as follows:

"Associates shall be firms, corporations, and individuals qualified by interest and activity in highway research who desire to further the work of the Board through annual contributions to its support. The annual fees shall be: individuals $3.00, firms and corporations $50.00. Associates shall be entitled to all the privileges of the Board except the right to vote."

There is no other grade of individual affiliation with the Highway Research Board, the voting power being vested only in the official representatives of the member organizations that constitute the Board. Individual associates and the official representatives of company associates will receive each year without other charge all issues of *Highway Research Abstracts* and at least one book of the annual *Proceedings*.

The only qualification necessary for affiliation is interest or activity in highway research, and applications from qualified persons and companies are invited. Further information can be secured from R. W. Crum, Director, Highway Research Board, 2101 Constitution Avenue, N.W., Washington, D.C.

Society Members Honored by A.W.W.A.

GEORGE H. FENKELL, M. Am. Soc. C.E., was one of the four men elected to honorary membership in the American Water Works Association at the January 1940 meeting of the board of that organization. The other selections were James E. Gibson of Charleston, S.C., John A. Kiehle of New York City, and Herbert M. Lofton of Chattanooga, Tenn.

Mr. Fenkell, retired general manager of the Board of Water Commissioners of Detroit, is described as "chief of Detroit's water department during a period of rapid expansion which called for the combination of high engineering ability and management skill." He has been a member of A.W.W.A since 1920, and was its president in 1931.

Also honored by A.W.W.A. were Thomas H. Wiggin and Melvin L. Enger, both Members, Am. Soc. C.E., for their joint paper on "A Proposed New Method for Determining the Barrel Thickness of Cast-Iron Pipe." This contribution was selected for the John M. Goodell prize "because it represents painstaking research, scholarly interpretation of results, adequate technical analysis, and presentation of matter of great importance in the water works field."

The annual convention of A.W.W.A. will be held in Kansas City, April 21 through 25—immediately following the Society's own Spring Meeting in the same city. Management of water works is to be particularly emphasized in the technical program.

Washington Award to Daniel Cowan Jackling

THE WASHINGTON Award Commission has elected Daniel Cowan Jackling, member of the American Institute of Mining and Metallurgical Engineers and president of the Utah Copper Company, as the recipient of the award for 1940. Presentation of the award, in the form of a bronze plaque, will be made at Dr. Jackling's convenience some time in April.

The Washington Award was founded in 1915 by John W. Alvord, Hon. M. Am. Soc. C.E., and is administered by the Western Society of Engineers. The American Society of Civil Engineers, as well as the other Founder Societies, is represented on the board of award. It is given annually "as an honor conferred upon a brother engineer by his fellow engineers on account of accomplishments which preeminently promote the happiness, comfort, and well-being of humanity."

Dr. Jackling was educated at the Missouri School of Mines, where he taught from 1891 to 1893. In 1900 he entered the employ of the Utah Copper Company, of which he was successively manager, general manager, managing director, and president. He is connected with numerous other mining companies and is known throughout the West for his activities in the field of copper mining. He has received, among other honors, the gold medal of the Mining and Metallurgical Society of America, the Saunders Gold Medal of the American Institute of Mining and Metallurgical Engineers, and the John Fritz Medal.

Prof. N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

PROFESSOR N. G. Neare told Haddah Nipp that a trip from the equator to either the Northeast or Northwest Pole at a ground speed of 100 miles per hour would consume 87.9 hours. He explained, "For each increment of northing the increment along the course flown will be greater in proportion to the secant of the azimuth of the course. Since the azimuth remains constant, the total distance flown must be $\sqrt{2}$ times the total northing, which latter is the earth's quadrant. Neglecting the refinements of Bessel and Clarke, the time consumed may be expressed as $19.78\pi\sqrt{2}$, or 87.9 hours."

Of course it may be doubted that the planes of Nipp and Tuck could negotiate the ever-sharpening curves of the spherical spiral; even if they had autogiros that could make the curves, it may be doubted that the problem speed could be maintained.

One member of the Engineers Club raised a point that seemed to be valid. "The course of the flight may be expressed in terms of the geographical coordinates of longitude ϕ and latitude λ, the differential form being:

$$d\phi = \sec \lambda \, d\lambda$$

leading to the explicit relation:

$$\phi = \log_e (\sec \lambda + \tan \lambda)$$

Now, at the end of the flight, the latitude will be 90° and the longitude will be infinity."

"Quite so," agreed Professor Neare, "but that doesn't make the distance infinite. Let that distance be s; for any differential portion, ds, let the east and north components be dx and dy, respectively. Then,

$$dy = R\,d\lambda$$

$$dx = R\cos\lambda\,d\phi,$$

Substituting your own equation for $d\phi$,

$$dx = R\cos\lambda\sec\lambda\,d\lambda = R\,d\lambda = dy$$

$$ds = \sqrt{dy^2 + dx^2} = \sqrt{2}\,dy = R\sqrt{2}\,d\lambda$$

$$s = \int_0^{\pi/2} R\sqrt{2}\,d\lambda = {}^1/_2\pi R\sqrt{2}$$

This, of course, is finite and supports my first answer."

"Instead of 100 miles per hour," concluded Explorer Nipp, "Tuck and I plan to cruise at 2,500 miles per day, leaving the crossways of equator and Greenwich Meridian at the same instant, so as to divide honors by arriving at the Northeast and Northwest Poles simultaneously. It really won't be a race—simply a Nipp and Tuck affair."

"But at that rate, you'll not arrive at the same instant," added the Professor. As he smilingly refused to explain his crypticism, it was overlooked during the send-off of bons voyages. But later it was remembered because of an astonishing verification.

Just what did the Professor have in mind?

"Modern Pioneer" Awards Recognize Civil Engineers

SEVEN MEMBERS of the Society are among the 500 men chosen from all parts of the country by the National Association of Manufacturers for special awards as "Modern Pioneers." They are: William P. Bentley of Dallas, Tex., Wallace L. Caldwell and Erskine Ramsay of Birmingham, Ala., Charles F. Kettering of Detroit, William M. White of Milwaukee, and Gano Dunn and Leon S. Moisseiff of New York City.

Selection was by a committee of scientists head by Karl T. Compton. The awards went to men "whose pioneering on the frontiers of industry has resulted in significant contributions to the American standard of living through increasing employment, providing a new commodity or service, reducing the cost of a product already in use, or improving the quality of a product already in use."

Backsights

FIFTY YEARS ago this month (on March 5, 1890) the letter-ballot on the codification of the Constitution was canvassed and the codification declared adopted. It is interesting to compare the membership classifications and requirements of that Constitution, as reproduced below, with those in force today:

"The Active Members of the Society shall be divided into three classes, to be styled, respectively, Members, Associates and Juniors. Associates and Juniors shall possess all the rights and privileges of Members, excepting the right of voting.

"A Member shall be a Civil, Military, Mining or Mechanical Engineer who has been in active practice as such for seven years, or has graduated as Civil Engineer and been in practice for five years, and has had responsible charge of work as Chief, Resident, or Superintending Engineer for at least one year; not as a skillful workman merely, but as one qualified to design as well as to direct public work.

"An Associate shall be a manager of a railroad, canal or other public work; a geologist, chemist or mathematician; a proprietor or manager of a mine or metallurgical works; an architect or a manufacturer; or one who, from his scientific acquirements or practical experience, has attained eminence in his special pursuit, qualifying him to cooperate with engineers in the advancement of professional knowledge; but shall not himself be practicing as an engineer.

"A Junior shall be one who has had actual practice in some of the branches of civil, military, mining or mechanical engineering, for not less than two years; or, if a graduate of a scientific or collegiate institution, for not less than one year.

"A person to be eligible to any class of Membership must not be less than twenty-one years of age."

Brief Notes from Here and There

"FLOOD VOLUMES" is the title of a 38-page photo-offset booklet by Robert E. Horton and Richard Van Vliek, just published by the Interstate Commission on the Delaware Basin. The object of the paper, say the authors, "is, by using a group of eastern streams as an example, to point the way to a broad geographic study of flood volumes which will give results useful in the design of flood control works." A limited number of copies are available for distribution, and the Commission is anxious "that they get into the hands of those who will find the work of particular interest." The Commission is located in the Broad Street Station Building, Philadelphia.

* * * *

"REFUSE MATERIALS," a 44-page bulletin by the American Public Works Association, has just been issued as "the preliminary edition of Chapter II of *Refuse Collection Practice*—a much larger work which has been in preparation for several years." The data presented are based on the practice of nearly 200 cities. Copies can be obtained from the Association, 1313 East 60th Street, Chicago, Ill., at 50 cents each.

* * * *

A SYMPOSIUM on "New Materials in Transportation" will be the technical feature of the 1940 spring meeting of the American Society for Testing Materials, to be held in Detroit, Wednesday, March 6. "Advances in the Use of Concrete in Transportation" is the topic of particular interest to civil engineers. Discussion will include such items as "Soil Stabilization" and "Soil Cement."

* * * *

"PUBLIC BUILDINGS" is the title of a 700-page volume recently published by the Federal Works Agency, illustrating the architecture of 620 selected projects built between 1933 and 1939 with the financial assistance of the Public Works Administration. The types of project represented include local government buildings, schools, institutions, warehouses, sanitary works, power plants, dams, bridges, highways, and airports. The book is for sale by the Superintendent of Documents, Washington, D.C., at $2.50 a copy.

* * * *

THE ANNUAL Midwest Power Conference, sponsored by Armour Institute of Technology in cooperation with other midwestern schools and a number of engineering societies, is scheduled for April 9 and 10 in Chicago. The program includes sessions on "Small Power Plants," "Hydro Power," "Fuel Problems," "Electrical Transmission," and "Gas Turbines."

NEWS OF ENGINEERS

Personal Items About Society Members

LLOYD T. MCAFEE, formerly utilities engineer for the Public Utilities Commission, City and County of San Francisco, has been appointed manager and chief engineer of the Hetch Hetchy Water Supply, Power, and Utilities Engineering Bureau.

FRANKLIN THOMAS, professor of civil engineering at California Institute of Technology, has been designated to receive the Arthur Noble Award for 1939, thus becoming the fifteenth recipient of the award, which was established in 1924 by the late Arthur Noble for "notable service to the city [Pasadena] in promoting the beauty or general welfare of the city during the year."

ALDEN D. HUNTING has resigned as associate bridge engineer in the bridge department of the California State Division of Highways to accept a position as resident engineer for J. E. Haddock, Ltd., contractors on the Cahuenga Pass Freeway near Hollywood.

WILLIAM J. STRIBLING, lieutenant, Civil Engineer Corps, of the U.S. Naval Reserve, is now resident officer in charge of construction for the U.S. Navy at the Naval Air Station, Sitka, Alaska.

DONALD A. GANNON, formerly junior engineer for the U.S. Soil Conservation Service at Glendora, Calif., is now with

the U.S. Department of Agriculture Flood Control Surveys, with headquarters at Watsonville, Calif.

ALEX DOW has retired as president of the Detroit Edison Company after forty-seven years of activity in the electric utilty field. Mr. Dow is an Honorary Member of the Society.

JAMES H. STRATTON, captain, Corps of Engineers, U.S. Army, is engineer in charge of the new U.S. Engineer Office at Caddoa, Colo. Captain Stratton was previously stationed in Boston, Mass.

A. F. HARTER has resigned as resident engineer inspector for the PWA at Safford, Ariz., in order to accept the position of city engineer of Globe, Ariz.

JASPER GERARDI, for the past ten years on the staff of the University of Detroit, was recently made acting head of the department of engineering drawing at the University of Detroit.

H. W. BIRKELAND has severed his connection with the U.S. Bureau of Reclamation at Denver, Colo., to accept a position with the Panama Canal Commission and is now engaged in construction work in the Canal Zone.

DONALD R. WARREN has resigned as senior bridge engineer for the California State Division of Highways in order to establish a consulting practice in Los Angeles.

MARTIN W. KEHART is now doing active duty as a lieutenant in the Civil Engineer Corps of the U.S. Navy on construction of the Pacific island air bases.

ROBERT A. ALLTON, who supervised construction of the new $4,000,000 sewage disposal plant at Columbus, Ohio, has been made superintendent of the plant. JAMES H. BLODGETT will serve as assistant superintendent.

L. H. HUNTLEY recently accepted a position as general superintendent of dam construction for the Great Lakes Dredge and Dock Company, of Chicago, Ill. He was formerly employed by the Ambursen Engineering Corporation on the construction of the Possum Kingdom Dam in Texas.

CARL M. NYE has been made chief engineer of the Great Northern Railway, succeeding J. R. W. DAVIS, who is retiring after many years of service. Mr. Nye has been assistant chief engineer of the line since 1920.

JOSEPH G. SHRYOCK has been promoted from the position of vice-president of the Belmont Iron Works, of Philadelphia, Pa., to that of president. He will continue as chief engineer of the organization.

JAMES F. SANBORN, of New York City, has been appointed consulting engineer to the Metropolitan District Water Supply Commission of Boston.

JOHN P. HOGAN, who has been serving as chief engineer and director of construction for the New York World's Fair, 1939, has resumed his engineering practice as a partner in the firm of Parsons, Klapp, Brinckerhoff and Douglas.

BENJAMIN FRANKLIN, civil and consulting engineer of Philadelphia, Pa., was elected a member of the Board of Managers of the Franklin Institute at its annual meeting held on January 17, 1940.

OSCAR S. BOWEN recently retired from active duty as assistant to the chief engineer of the Great Northern Railway after thirty-eight years of service with the line.

ERNEST KITCHEN, vice-president of the H. C. Nutting Company, of Cleveland, Ohio, will serve as coordinator of the Great Lakes water works project being carried out at Toledo, Ohio.

CHARLES E. SLOAN has been promoted from the position of assistant engineer of bridges for the Baltimore and Ohio Railroad to that of engineer of bridges, with headquarters in Baltimore, Md.

PHILIP W. HENRY was elected president of the American Institute of Consulting Engineers at the annual meeting of the organization, which was held in New York in January. OLE SINGSTAD was elected vice-president.

E. L. MACDONALD and S. A. THORESEN have been admitted as partners to the New York consulting firm of Parsons, Klapp, Brinckerhoff and Douglas.

SAMUEL SHULITS, formerly in charge of the Fluid Mechanics Laboratory at the Colorado School of Mines, is now with the Flood Control Division of the U.S. Engineer Office at Louisville, Ky.

EARL C. MYERS, JR., has been transferred from the post of junior hydraulic engineer at the Central Great Plains Experimental Watershed of the Soil Conservation Service at Hastings, Nebr., to that of assistant hydraulic engineer with the U.S. Forest Service. His first assignment is the flood control survey of the Pee Dee (North Carolina) River, with headquarters at Salisbury, N.C.

DON M. FORESTER, who is with the U.S. Bureau of Reclamation, has been assigned to duty as engineer in charge of investigations in the Rogue River Basin, with headquarters at Grants Pass, Ore. He was previously resident engineer on the Imperial Dam and desilting works of the All-American Canal Project at Yuma, Ariz.

BENJAMIN K. HOUGH, JR., was recently appointed lecturer in civil engineering at Cornell University. Mr. Hough is engineer in the Binghamton (N.Y.) District Office of the U.S. Engineer Department, being stationed at Ithaca.

J. JOHN MILLER, of Pittston, Pa., has been appointed assistant engineer in the Pennsylvania State Department of Health.

HARRY T. POE, JR., has resigned as senior engineer for the PWA on the Santee Cooper power and navigation project at Charleston, S.C., to go into general contracting in association with A. E. Morris. The firm is to be known as the Morris Poe Construction Company and will be located in the News Building at Greenville, S.C.

RAYMOND LAMOREAUX, lieutenant (jg), Civil Engineer Corps, U.S. Navy, has been transferred from the Navy Yard in Philadelphia to do duty in the 15th Naval District, Balboa, C.Z.

JOHN J. GOULD, until lately structural engineer for the Golden Gate International Exposition, has established a consulting structural engineering practice in San Francisco.

CHESTER W. OGDEN has been promoted from the position of assistant chief engineer for the Virginia Bridge Company at Roanoke, Va., to that of chief engineer, succeeding PAUL A. BLACKWELL, who has retired. Mr. Ogden's position will be filled by WILLIAM N. WOODBURY, formerly division engineer for the company at Birmingham, Ala.

U. S. GRANT, 3d, colonel, Corps of Engineers, U.S. Army, has been transferred from Governors Island, N.Y., where he was chief of staff of the 2d Corps Area, to serve as division engineer for the Great Lakes Division of the Corps of Engineers, at Cleveland, Ohio.

WILLIAM H. CONNELL has been appointed assistant director of public works of Philadelphia, Pa. He was formerly executive director of the Regional Planning Federation of the Philadelphia Tri-State District.

WILLARD S. CONLON has resigned as executive secretary of the National Society of Professional Engineers in order to devote himself more exclusively to the consulting practice that he maintains in Washington, D.C.

JOHN H. NEESON has been appointed to serve as director of public works of Philadelphia, Pa. At present Mr. Neeson is chief engineer of the Philadelphia Bureau of Engineering and Surveys.

RUBEN N. BERGENDOFF, for a number of years assistant engineer for Ash-Howard-Needles and Tammen, consulting engineers of New York and Kansas City, Mo., has been made a partner in the firm. Mr. Bergendoff is in the Kansas City office.

CHARLES L. FOX, chief engineer and purchasing agent for the Pennsylvania Water Company at Wilkinsburg, Pa., has been appointed general superintendent, succeeding the late W. C. HAWLEY. Mr. Fox will retain the title of chief engineer.

R. P. DAVIS, dean of the college of engineering at West Virginia University, has been appointed a member of a standing committee of the National Association of Land-Grant Colleges and Universities to study engineering instruction in the various schools.

G. DOUGLAS ANDREWS has organized a general construction firm under the name of Andrews and Andrews, Inc., at 400 Madison Avenue, New York City.

DECEASED

JAMES MACFARLANE ANGLE (M. '37) of Pittsburgh, Pa., died there in November 1939, at the age of 54. From 1914 to 1917 and from 1919 to 1922 Mr. Angle was in the Allegheny County (Pennsylvania) Engineer's Office. During the war he served as a lieutenant in the Corps of Engineers, U.S. Army. From 1922 until a short time before his death he was with the Public Roads Administration at Montgomery, Ala.—from 1931 on as senior highway bridge engineer. Mr. Angle moved to Pittsburgh a few months ago.

WILLIAM CHANNING CUSHING (M. '01) of Philadelphia, Pa., died in that city on January 11, 1940, at the age of 77. Mr. Cushing was in the service of the Pennsylvania Railroad for 44 years before his retirement—in 1932. In 1903 he was made chief engineer of maintenance of way on the Pennsylvania Lines West, and from 1920 on was engineer of standards on the staff of the chief engineer at Philadelphia. He was long active in the American Railway Engineering Association, which he at one time served as president, and was the author of numerous monographs.

WALTER A. DOANE (M. '81) civil engineer and surveyor of Meadville, Pa., died there on January 28, 1940, at the age of 85. Mr. Doane, the sixth oldest member of the Society in terms of length of membership, was actively engaged in the practice of his profession from the age of 18 till a week before his death. Early in his career he was employed on construction projects for various railroads, including the Canadian Pacific and the Norfolk and Western. From 1893 to 1905 he was city engineer of Meadville and later occupied the position again. Mr. Doane has been referred to as the greatest authority on the design and construction of wooden bridges.

GILBERT HAVEN FRIEND (M. '30) senior engineer in the U.S. Engineer Office at Pittsburgh, Pa., died at his home at Dormont, Pa., on January 25, 1940. Mr. Friend, who was 58, had been in charge of the railroad, public utility, and highway relocation section working in connection with the construction of flood control dams in the Pittsburgh District for the past two years. Before that he was engaged in similar work for the Zanesville (Ohio) District of the U.S. Engineer Office. Earlier in his career Mr. Friend was assistant chief engineer for the Western Maryland Railroad.

WILFRED GEORGE GEILE (M. '33) professor of structural engineering at North Carolina State College, Raleigh, N.C., died suddenly in his office in the civil engineering building there on January 27, 1940. Professor Geile, who was 44, joined the staff of North Carolina State College in 1927. Before that he served as instructor at his alma mater, Yale University; as structural designer for the Insley Manufacturing Company; and as field engineer for the Portland Cement Association.

The Society welcomes additional biographical material to supplement these brief notes and to be available for use in the official memoirs for "Transactions."

GLENN WILLIAM HOLMES (Jun. '37) for the past four years associate hydraulic engineer for the Soil Conservation Service at Washington, D.C., died at his home in Arlington, Va., on January 18, 1940. On February 1 Mr. Holmes would have been 30. Following his graduation from the University of Michigan—in 1932—he entered the office of Metcalf and Eddy, of Boston, Mass. Before going to Washington he was engaged in soil conservation work at Bath, N.Y. Mr. Holmes was the author of a number of technical articles.

DANIEL COLLINS LIPSCOMB (Assoc. M. '15) of Fort Worth, Tex., died on December 23, 1939, at the age of 52. From 1914 to 1918 Mr. Lipscomb was engineer for J. C. Field, consulting engineer of Denison, Tex. Later he served as city engineer of Durant, Okla., and as city engineer and water superintendent of Denison. In 1925 Mr. Lipscomb become superintendent of streets for the city of Fort Worth, holding this position until recently.

ARTHUR HERMANN MARKWART (M. '16) vice-president in charge of engineering for the Pacific Gas and Electric Company, San Francisco, Calif., died at his home at Piedmont, Calif., on January 25, 1940. He was 59. Mr. Markwart spent his early professional years as chief engineer and manager of the Syndicate Water Company of Oakland. From 1912 to 1915 he served as chief of construction of the Panama–Pacific International Exposition, and later maintained a consulting practice. He joined the Pacific Gas and Electric Company in 1920 as director of engineering, becoming vice-president in 1922.

LEWEN FIRTH SEARLE (Assoc. M. '08) assistant engineer for the New York City Department of Water Supply, Gas and Electricity (Catskill-Croton division), died at Kingston, N.Y., on January 23, 1940. Mr. Searle, who was 63, joined the engineering staff of the New York City Department of Water Supply in 1906. Before that he was in the employ of the New York Central Railroad.

JOSEPH CONRAD STEGNER (Assoc. M. '25) county road engineer for Pend Oreille County (Washington), died at Newport, Wash., on December 29, 1939. He was 57. Except for two years in private practice Mr. Stegner had been in the employ of Pend Oreille County since 1915, serving as county engineer in 1919 and 1920 and from 1923 on. Earlier in his career he was with the Northern Pacific Railroad.

SAMUEL MATTHEWS VAUCLAIN (M. '11) chairman of the board of the Baldwin Locomotive Works, Philadelphia, Pa., died on February 4, 1940, at the age of 83. Mr. Vauclain was in the employ of the Pennsylvania Railway System from 1872 to 1883. In the latter year he became connected with the Baldwin Locomotive Works. He was made a member of the company in 1896, vice-president in 1911, senior vice-president in 1917, and president in 1919. He was chairman of the board from 1929 on.

OWEN ADELBERT WAIT (Assoc. M. '05) of West Hollywood, Calif., died on January 9, 1940, at the age of 65. Mr. Wait spent the early years of his career with the Union Bridge Company and the Niagara Falls Power Company. Later he was designing engineer for the Great Northern Power Company and, for a number of years, was engaged in engineering work in California.

Changes in Membership Grades

Additions, Transfers, Reinstatements, and Resignations

From January 10 to February 9, 1940, Inclusive

ADDITIONS TO MEMBERSHIP

ABEL, JOHN STEWART (M. '40), Structural Engr., United Engrs. & Constrs., Inc., 1401 Arch St. (Res., 214 Henley Rd., West Park P. O.), Philadelphia, Pa.

ADAMS, WILLIAM EDWARD (Jun. '39), 34 King St., Hamden, Conn.

ALLEN, ROBERT THOMAS (Jun. '39), Soils Engr., Portland Cement Assoc., 33 West Grand Ave., Chicago, Ill.

ANDERSON, FRANK OSCAR (Jun. '39), Draftsman, Ferry County, Republic (Res., 3304 East K St., Tacoma), Wash.

ANTHON, HAROLD SEVERIN (Jun. '39), 5120 Eddy St., Chicago, Ill.

ARTIGLIA, ALDO (Jun. '39), Designing Engr., Niagara-Hudson Power Corporation, 300 Elec. Bldg. (Res., 450 Carlton St.), Buffalo, N.Y.

ASAM, MITAT SAIT (Jun. '40), International House, Berkeley, Calif.

ATKINS, LAYSON ENSLOW (M. '40), Dist. Engr., Seattle Dist., U.S. Engr. Office, 700 Central Bldg., Seattle, Wash.

AVERY, STUART BENJAMIN, JR. (Jun. '40), Mgr., Plymouth Area, White Mountain Power Co., 68 Main St. (Res., 10 Cummings St.), Plymouth, N.H.

BATES, CHARLES RUSSELL (Jun. '39), Junior Agri. Engr., SCS, U.S. Dept. of Agriculture, Camp 25A (Res., 17 Hotel Olive), Safford, Ariz.

BAUER, HORACE PETER (Jun. '39), Detailer, Bethlehem Steel Co., South Keim (Res., 170 North Charlotte St., Apartment 3), Pottstown, Pa.

BENNETT, CARL MELVIN (Jun. '39), Acting Chf., Dept. of Public Works (Res., 828 Grand Ave.), Grand Junction, Colo.

BEVE, CARL ERIC (Jun. '40), Civ. Engr., White and Burke, 9 Andrews St. (Res., 95 Federal St.), Springfield, Mass.

BIESACK, STANLEY ROBERT (Jun. '40), Asst. Eng. Aid, TVA, Found Bldg. (Res., 856 Oak St.), Chattanooga, Tenn.

BINNINGS, CLEM BURKE (Jun. '39), Asst. City Engr., City of New Orleans, City Hall (Res., 379 Broadway), New Orleans, La.

BLANCHARD, CARROLL FRANCIS (M. '40), Associate Grade Separation Engr., State Dept. of Public Works, State Office Bldg. (Res., 206 Whitehall Rd.), Albany, N.Y.

BOYD, HERBERT HENRY (M. '40), Supervisor of Buildings, State Highway Dept., Highway Bldg. (Res., 206 Hub St.), Jefferson City, Mo.

BRADFORD, THOMAS ALDEN (Assoc. M. '40), Asst. Engr., Capital Transit Co., 36th and M St., N.W. (Res., 3335 Quesada St., N.W.), Washington, D.C.

BRAULT, LAWRENCE ELMER (Jun. '39), Research Laboratory Asst., Portland Cement Assoc., 33 West Grand Ave., Chicago (Res., 713 South Humphrey Ave., Oak Park), Ill.

BROCKOB, WILLIAM LUDWIG (Jun. '39), 1815 South Austin Boulevard, Cicero, Ill.

BUTLER, ELMER (Jun. '39), Civ. Engr., U.S. SCS, 161 South 10th East, Salt Lake City, Utah.

BUTLER, VIRGE M. (Jun. '39), Care, State Road Comm., Huntington, Utah.

CAMERON, HARRY FRANK, JR. (Jun. '39), Ranger, U.S. National Park Service, Death Valley, Calif.

CARLSON, ERNEST CARL (Jun. '39), Structural Detailer, Page Eng. Co., Clearing P. O. (Res., 1424 North Leamington Ave.), Chicago, Ill.

CHADERTON, JULIAN CUTHBERT (Assoc. M. '39), Civ. Engr., 4702 North Winchester Ave., Chicago, Ill.

CHASE, PAUL HIRAM (Jun. '39), Student Eng. Personnel Asst., State Civ. Service Dept., 110 West Ottawa St., Lansing, Mich.

CLANCY, ERNEST IRVIN (Jun. '40), Junior Hydr. Engr., U.S. Geological Survey, Box 56, Montgomery, Ala.

COCHRANE, ROBERT BAXTER (Assoc. M. '40), Associate Engr., War Dept., U.S. Engr. Office, Bonneville, Ore.

COLVIN, GRATTAN CATCHINGS (Jun. '39), Junior Hydr. Engr., U.S. Geological Survey, Box 2052, Jackson, Miss.

COPEN, MERLIN DENVER (Jun. '39), Graduate Asst., Kansas State Coll. (Res., 913 Leavenworth), Manhattan, Kans.

CORMACK, BRUCE LOGUE (Jun. '39), Structural Draftsman, Am. Bridge Co., Ambridge (Res., 606 Locust Pl., Sewickley), Pa.

CROSSON, RAYMOND LOGAN, JR. (Jun. '39), Insp., Ash-Howard-Needles & Tammen, 1012 Baltimore Ave., Kansas City, Mo. (Res., 505 South Union St., Natchez, Miss.)

CUSHING, ELLIOTT MORSE (Jun. '39), Recorder, Ground Water Div., U.S. Geological Survey, Box 2631 (Res., Rialto Apartments, Apartment 2), Tucson, Ariz.

DAVIES, DAVID LLOYD, JR. (Jun. '39), Junior Hydr. Engr., Water Resources Branch, U.S. Geological Survey, 208 Millsaps Bldg., Jackson, Miss.

DINGWELL, ALEXANDER GORDON (Jun. '39), Eng. Asst., Andrew S. Huntington, 1333 Post Rd., Fairfield (Res., 397 Bridgeport Ave., Devon), Conn.

DREIER, CLARENCE JOSEPH (Jun. '40), Executive Supervisor, Dreier & Son Const. Co., 640 Minnesota (Res., 331 North 17th St.), Kansas City, Kans.

DROSKIN, MORRIS (Jun. '39), Junior Engr., U.S. Bureau of Reclamation, Customhouse Bldg., Denver, Colo.

ECKERSON, JAMES BLAKE (Jun. '39), Junior Draftsman, Tide Water Associated Oil Co., 79 New Montgomery (Res., 1901 Jackson St.), San Francisco, Calif.

FARLOW, JOSEPH NEWTON (Jun. '39), Asst. Engr., John D. Spinks, 307 Reynolds Bldg., Winston-Salem, N.C.

FERRERO, CARLOS LUIS (Assoc. M. '39), Insp., Tecnico General, Ministerio de Obras Publicas (Res., Ave., Los Pinos 12- La Florida), Caracas, Venezuela.

FINNEY, EDWIN ASHLEY (Assoc. M. '39), Asst. Research Engr., State Highway Dept., Room 3 Olds Hall, Michigan State Coll. (Res., 935 Sunset Lane), East Lansing, Mich.

FORNELLI, JOE PETE (Jun. '39), Civ. Engr., The Carter Oil Co., St. Elmo, Ill. (Res., Cherokee, Kans.)

FORSBERG, GEORGE WILHELM (Assoc. M. '40), Asst. Structural Engr., U.S. Dept. of Agriculture, FSA, 85 Second St., San Francisco (Res., 1116 Curtis St., Albany), Calif.

FREEMAN, DELBERT BLISS (Assoc. M. '39), Engr. (Civ.), Corps of Engrs., U.S.A., 10 East 17th St., Kansas City, Mo.

GABARDI, ALBERT ISIDORO (Jun. '39), Junior Engr., Dept. of Interior, U.S. Bureau of Reclamation, 339 Federal Bldg. (Res., 3349 South 20th East), Salt Lake City, Utah.

GALLAGHER, THOMAS FRANCIS (Jun. '39), Care, H. F. Stimm, Inc., 955 Ellicott Sq., Buffalo, N.Y.

GARLAND, CHESLEY FISHER (Jun. '39), Junior Asst. San. Engr., San Eng. Bureau, State Health Dept., 2411 North Charles St. (Res., 604 Radnor Ave.), Baltimore, Md.

GOMEZ, MANUEL (Jun. '39), Graduate Asst., Civ. Eng. Dept., Univ. of Florida, Gainesville, Fla.

GORDON, LEONARD MICHAEL (Jun. '39), 6571 Hiawatha Drive, Chicago, Ill.

GORNITZKY, RAYMOND (Jun. '39), Chf. of Party, State Geodetic Control Survey, 200 Washington St. (Res., 300 Seymour Ave.), Newark, N.J.

GOULD, IRVINE PHILLIPS (Jun. '40), Designer, Parsons, Klapp, Brinckerhoff & Douglas, 142 Maiden Lane (Res., 779 Riverside Drive), New York, N.Y.

GUNDERSON, EDWARD HUNT (Jun. '39), Junior Engr., Engr. Dept. at Large, 415 Post Office and Court House, Norfolk, Va.

HARRIS, WILLIAM RANDOLF, JR. (Jun. '39), Tracer, Tennessee Coal, Iron & R. R. Co., Rail Transportation Works, Ensley (Res., 1700 Seventh Ave., West, Birmingham), Ala.

HEDLEY, WILLIAM JOSEPH (M. '39), Constr. Engr., Wabash Ry., 1402 Railway Exchange Bldg., St. Louis, Mo.

HEMMERT, JOHN LESLIE (Assoc. M. '39), Senior Physical Testing Engr., State Div. of Highways, 3435 Serra Way, Sacramento, Calif.

HERRON, WILLIAM JAMES, JR. (Jun. '39), Asst. Eng. Aid, U.S. Engr. Dept., 7 College Ave. (Res., 540 Humbolt Ave.), Santa Rosa, Calif.

HEWITSON, RAYMOND EUGENE (Jun. '39), Civ. Engr., Western Laboratories, 921 Q St., Lincoln, Nebr.

HITCHCOCK, CHARLES YOUNG, JR. (Jun. '39), Insp. and Draftsman, Gannett, Eastman & Fleming, Inc., 600 North 2d St., Harrisburg (Res., 524 Bosler Ave., Lemoyne), Pa.

HORNER, RALPH BUNTING (M. '40), Structural Engr., Duquesne Light Co., 435 Sixth Ave., Pittsburgh, Pa.

TOTAL MEMBERSHIP AS OF FEBRUARY 9, 1940	
Members	5,583
Associate Members	6,346
Corporate Members	11,929
Honorary Members	31
Juniors	4,150
Affiliates	70
Fellows	1
Total	16,181

HORTON, CHARLES HENRY (Jun. '39), Instrumentman, State Highway Dept., 2 Highland Ave., St. Johnsbury, Vt.

HOWARD, MILTON WILLIAMS, III (Jun. '39), Junior Engr., TVA, Murray, Ky. (Res., 792 Virginia Circle, N.E., Atlanta, Ga.)

HUTTO, WALTER CLYDE (Assoc. M. '39), Asst. Structural Engr., Constr. Plant Div., TVA, 200 Arnstein Bldg. (Res., 117 Fairview Ave.), Knoxville, Tenn.

IRISH, SUMNER BARTHOLF (Jun. '40), 744 John Jay Hall, Columbia Univ., New York, N.Y.

JACKSON, WALTER MAX (Jun. '39), With J. T. Ryerson & Son, Inc., 40 Stanley St., Buffalo (Res., 31 St. Joseph, Lancaster), N.Y.

JACOBSON, JOHN (Jun. '39), Engr., The Inland Utilities Co., Scott City, Kans.

JIMENEZ LOPEZ, JORGE JAIME (Assoc. M. '39), Asst. State Director of Operations, WPA, San Juan (Res., 35 Estado St., Santurce), Puerto Rico.

JOHNSON, JOHN FRANK (M. '40), Chf. Engr., Dept. of Public Works, City of New York, Room 1818 Municipal Bldg., New York, N.Y.

KELLEY, HOWARD LESLIE (Jun. '39), Rodman, C. M. St. P. & P. R. R. (Res., 604 South Jay St.), Aberdeen, S.Dak.

KERR, JOHN THOMPSON (Jun. '40), with Consolidated Eng. Co., 20 East Franklin St., Baltimore, Md. (Res., 156 Irving Rd., York, Pa.)

KILGORE, CLARENCE BOYD (Jun. '39), Rodman, Gravity Service Co., Box 6005, Houston, Tex.

KINGSTON, JOSEPH ROY, JR. (Jun. '40), 521 Beecher St., Louisville, Ky.

KNAPP, LEO JAY (M. '40), Secy., Whitehead & Kales Co., 58 Haltiner St., Detroit, Mich.

KNOLL, JOHN JACOB (Jun. '39), Engr., WPA, Mayville, N.Dak.

KOCH, ALVA ERNST (Jun. '39), Laboratory Technician, U.S. Waterways Experiment Station, Soils Laboratory, Vicksburg, Miss.

KRAUSS, HAROLD (Jun. '40), Junior Engr., War Dept., 7th and Walnut Sts., Cincinnati, Ohio.

LANGE, KENNETH WILSON (Jun. '39), Asst. in Civ. Eng., Yale Univ., 15 Prospect St., New Haven, Conn.

LARSON, ALVIN (Assoc. M. '40), Civ. Engr., Gulf Oil Corporation, Gulf Bldg., Pittsburgh (Res., 215 Chestnut St., Sewickley), Pa.

LEVY, TOBIAS EDWIN (Assoc. M. '39), Structural Engr., 6629 Wayne Ave., Philadelphia, Pa.

LOMBARDI, MILTON CLIFFORD (Jun. '40), 45 Parkway Drive, Port Chester, N.Y.

MCCORD, MAX (Jun. '39), Engr., Magnolia Petroleum Co., Box 900, Dallas, Tex. (Res., 325 North 14th St., Manhattan, Kans.)

MCFARLAND, SIDNEY LANIER (Jun. '39), Asst. Engr., Central of Georgia Ry., Office of Chf. Engr., Savannah, Ga.

MCINERNEY, HENRY BERNARD (Jun. '40), Engr., The Reinhart & Donovan Co. (Res., 2145 North West 15th St.), Oklahoma City, Okla.

MCMILLAN, RALPH CHARLES (Jun. '39), Draftsman, Link Belt Co., 300 West Pershing Rd. (Res., 8742 South Ashland Ave.), Chicago, Ill.

MCMILLAN, WILLIAM TERRELL (Jun. '39), Asst. Eng. Draftsman, TVA, 711 Union Bldg., Knoxville, Tenn.

MARK, JACOB (M. '40), Cons. Engr., 285 Madison Ave., New York (Res., 101 Lafayette Ave., Brooklyn), N.Y.

MARSHALL, JOHN STANLEY (Assoc. M. '40), Chf. Draftsman, State Highway Dept., Colfax at Sherman (Res., 298 South Williams St.), Denver, Colo.

MARTIN, JOHN EDWARD (Jun. '39), Engr., Albert C. Martin, 233 Higgins Bldg., Los Angeles, Calif.

MAST, EARL LEROY (Jun. '39), Junior Engr., Cleveland Met. Housing Authority, West Mall Drive (Res., 7500 Euclid Ave.), Cleveland, Ohio.

MATHEWS, OLIVER WELLESLEY (Jun. '39), Care, Shell Co. of Australia, Bracks St., Nth Fremantle, Western Australia.

MATTHEWS, WILLIAM LEE, JR. (Jun. '39), Asst. Civ. Engr., Project and Survey Section, Civ. Aeronautics Authority, Washington, D.C.

MEADOWS, HENRY EDWARD (Jun. '39), Dist. Civ. Engr., Humble Oil & Refining Co., Box 71, Wharton, Tex.

MELTZER, BERNARD (Jun. '39), Junior Engr., U.S. Engr. Office, Chamber of Commerce Bldg., Pittsburgh, Pa.

MOCK, ALVIN McGEE (Assoc. M. '39), Asst. Engr., Gascoigne & Associates, Leader Bldg. (Res., 2592 Mayfield Rd.), Cleveland, Ohio.

MONROE, DONALD MARK (Jun. '39), Asst. Engr., Dickinson County Road Comm. (Res., 1001 River Ave.), Iron Mountain, Mich.

MORKEN, PAUL GILBERT (Jun. '39), Junior Hydr. Engr., U.S. Geological Survey, Federal Bldg., Boise, Idaho.

ODOM, JAMES JULIUS (Assoc. M. '39), Div. Materials Engr., State Highway Dept., 930 Martin Bldg., Birmingham, Ala.

OLMSTEAD, WILLIAM WALDEMAR (Jun. '39), Inspection Engr., Atlantic Mutual Insurance Co., 49 Wall St., New York (Res., Plum Tree Lane, Hempstead), N.Y.

OWNBEY, CHARLES RAY (Jun. '40), Eng. Aide, USHA, 258 Virginia Ave., West (Res., 1514 West Cumberland Ave.), Knoxville, Tenn.

PALMBERG, HERBERT GEORGE (Assoc. M. '39), Asst. Engr., War Dept., U.S. Engrs., 628 Pittock Blk., Portland (Res., Scappoose), Ore.

PAVITT, STEVAN SYLVANUS (Jun. '39), Draftsman, Delineator, Bridge Dept., State of California, Box 1499 (Res., 2770 Portola Way), Sacramento, Calif.

PAYNE, ALAN SUTCLIFFE (Jun. '39), Junior Engr., U.S. Bureau of Reclamation, Redding, Calif.

PEBEL, SIGMUND JOHN (Jun. '40), Eng. Asst., Dept. of Public Works, 150th Ave. and 132d St., South Ozone Park (Res., 482 Junius St. Brooklyn), N.Y.

PIERCE, LOUIS DALE (Jun. '39), Engrs. Asst., New England Power Service Co., 441 Stuart St. (Res., 386 Riverway, Suite 8), Boston, Mass.

PIERCE, RAYMOND WILCOX (Jun. '40), Asst. Hydr. Engr., U.S. Dept. of Agriculture, Forest Service, Buffington Bldg., Kittanning, Pa.

PLATT, WILLIAM ALLAN (Jun. '40), Eng. Aide, U.S. Engrs., St. Paul Dist., Box 517, Wheaton, Minn.

POWELL, RICHARD WILLIAM (Jun. '39), Junior Civ. Engr., SCS, U.S. Dept. of Agriculture, Thibodaux, La. (Res., 1457 South 3d, Terre Haute, Ind.)

PRASSAS, MILTIADES JOHN (Jun. '39), Structural Engr., Holabird & Root, 333 North Michigan Ave. (Res., 5511 Wayne Ave.), Chicago, Ill.

REID, ANDREW BUDGE (Jun. '39), Arch. Engr., S. N. Nielsen Co., 3133 West North Ave. (Res., 1027 Newport Ave.), Chicago, Ill.

REUTTER, JOHN G. (Jun. '39), Engr., National Memorial Park, Falls Church, Va. (Res., 106 Chestnut St., Clayton, N.J.)

REYES, TOMAS DE LOS (Jun. '39), Civ. Engr., 475 Padre Rada, Tondo, Manila, Philippine Islands.

ROCKWOOD, DAVID MURDOCK (Jun. '40), Junior Engr., U.S. Engr. Dept., 628 Pittock Blk., Portland, Ore.

ROGERS, ANDREW WIER, JR. (Jun. '39), Curing Foreman, Austin Road Co., 1813 Clarence, Dallas, Tex.

SALIMAN, ARMAND (Jun. '39), Instrumentman, Dominion Govt., Medicine Hat, Alberta (Res., 2225 Winnipeg St., Regina, Saskatchewan), Canada.

SCHWARTZ, JOSEPH WALLACE (Jun. '39), 232 Powell St., Brooklyn, N.Y.

SEBASTIAN, FRANK BENEDICT (Jun. '39), 2238 Argyle St., Chicago, Ill.

SHELFORD, JOHN (Jun. '39), Junior Engr. (Structural), U.S. Engr. Dept., C. & O. Bldg. (Res., 324 Fifth St.), Huntington, W.Va.

SHIELDS, JAMES EDWARD (Jun. '39), 12 Sumner Rd., Cambridge, Mass.

SHINE, BARTHOLOMEW JENNINGS (M. '40), Prof., Structural Eng., Univ. of Cincinnati (Res., 250 Greendale Ave.), Cincinnati, Ohio.

SMITH, JOHN PHILIP, JR. (Jun. '39), Supervisor of Surveys, U.S. Engr. Dept., Gravelly Airport (Res., 1657 Newton St., N.W.), Washington, D.C.

SORENSEN, KENNETH EDWARD (Jun. '39), 116 Third St., Neenah, Wis.

STANLEY, IRA LLOYD (Jun. '39), Engrs. Asst., State Highway Dept., State Capitol Bldg. (Res., 326 North Euclid), Pierre, S.Dak.

STICE, ROBERT PHILIP (Jun. '39), Junior Engr. (Civ.), U.S. Army Engrs., Bonneville, Ore.

STOECKER, CHARLES EDWARD (Jun. '40), Rodman, L. & N. R. R., Union Station (Res., 1627 Story Ave.), Louisville, Ky.

TAGGART, LLOYD WELCH (Jun. '39), Timekeeper, Taggart Constr. Co., 1343 Salisbury Ave., Cody, Wyo.

THEIS, WILLIAM TILGHMAN (Jun. '39), Apprentice Engr., Phillips Petroleum Co., Bartlesville, Okla.

TICE, EDMUND JACKSON (Jun. '39), Insp. of Costs, Office of Asst. to Gen. Mgr., Norfolk & Western Ry. (Res., 587 Arlington Rd.), Roanoke, Va.

TOMSICH, EDWARD (Jun. '39), with Giffels & Vallet, 1000 Marquette Bldg. (Res., 412 West Grand Boulevard), Detroit, Mich.

TRASK, CHARLES WESLEY (Jun. '39), Camp Engr., SCS, Camp SCS 26 N, Rodeo, N.Mex.

TUBBS, LESTER SAWTELL (Assoc. M. '39), Asst. Engr., The Bonneville Project, 4943 Union and Alberta Sts. (Res., 6506 South East 20th St.), Portland, Ore.

TURNER, ANDREW MORRIS (Jun. '39), 809 Riverside Drive, New York, N.Y.

VANDERHOOP, RICHARD ALLEN (Jun. '39), Student Engr., U.S. Engrs., Federal Bldg. (Res., Fenwick Club), Cincinnati, Ohio.

VOLLMER, JOSEPH FRANCIS (Jun. '39), Special Apprentice, Bucyrus-Erie Co., South Milwaukee (Res., 2949 North Frederick Ave., Milwaukee), Wis.

WARRINGTON, JOHN BURWELL, JR. (Jun. '39), Engr. in Training, E. I. du Pont de Nemours & Co. (Res., 187 Prospect St.), Newburgh, N.Y.

WEIDNER, EVERETT LEVERN (Jun. '39), Insp., Ash-Howard-Needles & Tammen, 1012 Baltimore Ave., Kansas City, Mo. (Res., 505 South Union St., Natchez, Miss.)

WILLIAMS, HAROLD HERBERT (Jun. '39), Eng. Apprentice, M. of W. Dept., P. R. R., Eastern Region (Res., 16 West 6th St.), New Castle, Del.

WILLIAMS, JOSEPH ANTHONY (Jun. '39), With Elec. Generation Dept., Public Service Elec. & Gas Co., Marion Generating Station, Jersey City (Res., 755 South Orange Ave., Newark), N.J.

WILSON, ROBERT EUGENE (Jun. '39), Junior Office Asst., Bridge Div., State Highway Dept., State Highway Bldg. (Res., 1208 San Jacinto St., Austin, Tex.

WOLLETT, EDWARD, JR. (Jun. '39), Asst., Eng. Corps, P. R. R., 1401 Clinton St., Fort Wayne, Ind. (Res., 1010 Walnut St., Williamsport, Pa.)

WOODSON, EVERARD MEADE, JR. (Jun. '39), Junior Engr., International Boundary Comm., United States and Mexico, San Benito, Tex.

WORSHAM, CLIFFORD GREEN (Jun. '40), Senior Foreman, Engr., U.S. Dept. of Interior, Tishomingo State Park, Tishomingo (Res., Corinth), Miss.

WORTHAM, HARRY ADAMS (M. '39), Regional Director (Region 3), PWA, 150 Hurt Bldg., Atlanta, Ga.

WOY, JACK ALLAN (Jun. '39), Insp., Chicago Board of Underwriters, 175 West Jackson Boulevard, Chicago, Ill.

WRAY, BESWICK (Jun. '39), Care, State Highway Dept., Refugio, Tex.

YAW, JOHN WARD (Jun. '39), Draftsman, Babcock & Wilcox Co., 184 Sixth, N.W., Barberton, Ohio.

MEMBERSHIP TRANSFERS

ADAMS, CYRIL SAMUEL (Jun. '30; Assoc. M. '40), Designing Engr., Lower Colorado River Authority, 820 Littlefield Bldg., Austin, Tex.

CHAMPLIN, GEORGE DELONG (Jun. '30; Assoc. M. '40), Asst. Engr., Lago Petroleum Corporation, Apartado 172, Maracaibo, Venezuela.

COOKMAN, WILLARD GEORGE MINTER (Jun. '36; Assoc. M. '39), Insp., U.S. Engr. Dept., Post Office Bldg., Joliet (Res., 1219 Wauponsee St., Morris), Ill.

COONS, ALFRED DEVORE (Jun. '31; Assoc. M., '39), Res. Engr., Univ. of California, Coll. of Agriculture (Res., 228 Rice Lane), Davis, Calif.

CROOM, THOMAS GREEN (Jun. '30; Assoc. M. '39), Engr., Bureau of San. Eng., State Board of Health, 1098 West Michigan St., Indianapolis, Ind.

JOHNSON, CHARLES JAMES (Jun. '33; Assoc. M. '39), Engr. and Estimator, Hammond Eng. Co. (Res., 4511 North East Glison St.), Portland, Ore.

JOHNSTONE, DON (Jun. '32; Assoc. M. '40), Asst. Editor, *Civil Engineering* (Am. Soc. C.E.), 33 West 39th St., New York, N.Y.

MACNISH, CHARLES FRASER (Jun. '30; Assoc. M. '40), Civ. Engr., Corps of Engrs., U.S.A., 831 U.S. Court House and Customhouse, St. Louis, Mo.

MCCAUGHAN, FRANK ALLAN (Jun. '36; Assoc. M. '40), Asst. Engr., Myers & Noyes, 2206 Tower Petroleum Bldg. (Res., 5242 Vickery Boulevard), Dallas, Tex.

MCGOWAN, JOHN (Jun. '37; Assoc. M. '39), Field Engr., The Thompson Mfg. Co., 3001 Larimer St. (Res., 433 Gilpin St.), Denver, Colo.

MCLEAN, RALPH STEWART (Jun. '30; Assoc. M. '39), Structural Engr., 141 South Madrona Ave., Brea, Calif.

MARKS, CONSTANT ROBERTS, III (Jun. '28; Assoc. M. '40), Asst. Structural Engr., TVA, 300 Arnstein Bldg., Knoxville (Res., 130 Conner Ave., Fountain City), Tenn.

MARR, GEORGE JOHNATHON (Jun. '37; Assoc. M. '39), Engr., East Bay Municipal Utility Dist., 512 Sixteenth St., Oakland (Res., 1103 Keeler Ave., Berkeley), Calif.

OBERMANN, ROBERT FRANK (Jun. '32; Assoc. M. '40), Supervisor of Operations and Eng., Plant Dept., Jamaica Water Supply Co., 162–20 Eighty-Ninth Ave. (Res., 106–22 Ruscoe St.), Jamaica, N.Y.

RILEY, JOHN PHILIP (Assoc. M. '29; M. '40), Management Deputy and Acting Constr. Deputy, New York City Housing Authority, 122 East 42d St., New York (Res., 35–33 Eighty-Third St., Jackson Heights), N.Y.

SCHARPENBERG, CHARLES CHRISTIAN (Assoc. M. '17; M. '40), 2300 Eighteenth St., Bakersfield, Calif.

SHERRARD, HOWARD MACOUN (Jun. '23; Assoc. M. '25; M. '39), Asst. Chf. Engr., Dept. of Main Roads, Box 3903, G. P. O., Sydney, N.S.W., Australia.

SMITH, WALDO EDWARD (Jun. '27; Assoc. M. '32; M. '40), Hydr. Engr., Muskingum Watershed Conservancy Dist., 205 North Broadway (Res., 479 East High Ave.), New Philadelphia, Ohio.

STRAUB, LORENZ GEORGE (Jun. '28; Assoc. M. '34; M. '40), Prof. of Hydraulics; Director, St. Anthony Falls Hydr. Laboratory, Univ. of Minnesota, 133 Main Eng. Bldg., Univ. of Minnesota, Minneapolis, Minn.

STUBBS, FRANK LYCURGUS (Jun. '33; Assoc. M. '39), Junior Res. Engr., State Highway Dept., Georgetown, Tex.

THOMPSON, PAUL WILLIAMS (Jun. '33; Assoc. M. '39), Capt., Corps of Engrs., U.S.A., Fort Belvoir, Va.

WARNER, ROY FERDINAND (Jun. '35; Assoc. M. '39), Asst. Engr., U.S. Engrs., War Dept., Hydr. Laboratory (Res., 521 Melrose Court), Iowa City, Iowa.

WICKES, GORDON FRANK (Assoc. M. '20; M. '40), Pres., Wickes Eng. & Constr. Co., 1441 Second Ave., Des Moines, Iowa.

WICKES, HOWARD CHARLES (Assoc. M. '20; M. '40), Secy.-Treas., Wickes Eng. & Constr. Co., 1441 Second Ave., Des Moines, Iowa.

WOODBURN, RUSSELL (Jun. '29; Assoc. M. '40), Associate Agri. Engr. (Station Engr.), U.S. SCS, Box 208, Zanesville, Ohio.

REINSTATEMENTS

BAKER, ROLAND GAIL, M., reinstated Jan. 9, 1940.

BAWDEN, ALBERT JOHN, Assoc. M., reinstated Jan. 24, 1940.

BROWN, ERNEST MACK, Assoc. M., reinstated Feb. 6, 1940.

COSTA, JOHN JOSEPH, Assoc. M., reinstated Feb. 3, 1940.

CUTTING, GEORGE WARREN, JR., Assoc. M., reinstated Jan. 24, 1940.

EBERLY, VIRGIL ALLEN, Assoc. M., reinstated Jan. 22, 1940.

FICKES, EUGENE WELDON, Assoc. M., reinstated Feb. 1, 1940.

FRASER, ROBERT MARSHALL, Assoc. M., reinstated Jan. 12, 1940.

HANDEYSIDE, CHARLES AUGUSTUS, Assoc. M., reinstated Jan. 11, 1940.

HENDRY, JAMES ROWLEY, M., reinstated Jan. 8, 1940.

INTEMANN, HENRY LUTHER, Assoc. M., reinstated Feb. 1, 1940.

KRAUSE, MARK CHAMPION, M., reinstated Jan. 16, 1940.

LAUCOMER, GEORGE FRANKLIN, Jun., reinstated Feb. 4, 1940.

LENOX, JACOB LEON, Assoc. M., reinstated Jan. 29, 1940.

NYQUIST, ROY ALFRED, Assoc. M., reinstated Feb. 1, 1940.

ORRISON, WILLIAM WALLACE, Jun., reinstated Jan. 22, 1940.

RANKIN, ARDERY ROBERT, Jun., reinstated Jan. 19, 1940.

RUHLING, GEORGE HUTZE, Assoc. M., reinstated Jan. 22, 1940.

SCHMIDT, MILTON ELMER, Jun., reinstated Feb. 5, 1940.

SMITH, BERNARD JOSEPH, Assoc. M., reinstated Jan. 10, 1940.

STEPHENS, PHILIP FREDERICK, Assoc. M., reinstated Jan. 17, 1940.

SUMMERS, RICHARD ELVIN JEWELL, M., reinstated Jan. 31, 1940.

VAUGHAN, HENRY FRIESE, Assoc. M., reinstated Jan. 16, 1940.

WAALKES, GERRIT, Assoc. M., reinstated Feb. 5, 1940.

WIESENBERG, WILLIAM MAURICE, Assoc. M., reinstated Feb. 6, 1940.

RESIGNATIONS

BIGELOW, LAWRENCE NEAL, Jun., resigned Jan. 30, 1940.

BOEHLKE, JOHN HENRY, Jun., resigned Jan. 10, 1940.

BOYLE, BLAIR, M., resigned Jan. 11, 1940.

CAPELLE, ERNEST ANDREW, Jun., resigned Feb. 7, 1940.

COUCH, EUGENE, M., resigned Feb. 1, 1940.

GERST, HARRY AUGUST, M., resigned Jan. 30, 1940.

GOLDENBERG, JOSEPH WILLIAM, Jun., resigned Feb. 1, 1940.

HAM, CAVIS BEECHER, Jun., resigned Feb. 1 1940.

JOHNSON, ALBERT EDWIN, Jun., resigned Feb. 1, 1940.

MOHLER, FRANKLIN CALVIN, Jun., resigned Jan. 30, 1940.

SKINNER, ALFRED EDWIN, M., resigned Feb. 1, 1940.

THOMPSON, JAMES ARTHUR, Assoc. M., resigned Feb. 1, 1940.

ZIEGLER, ADAM, Assoc. M., resigned Feb. 1, 1940.

Applications for Admission or Transfer

Condensed Records to Facilitate Comment from Members to Board of Direction

March 1, 1940 NUMBER 3

The Constitution provides that the Board of Direction shall elect or reject all applicants for admission or for transfer. In order to determine justly the eligibility of each candidate, the Board must depend largely upon the membership for information.

Every member is urged, therefore, to scan carefully the list of candidates published each month in CIVIL ENGINEERING *and to furnish the Board with data which may aid in determining the eligibility of any applicant.*

It is especially urged that a definite recommendation as to the proper grading be given in each case, inasmuch as the grading must be based upon the opinions of those who know the applicant personally as well as upon the nature and extent of his professional experience. Any facts derogatory to the personal character or professional reputation of an applicant should be promptly communicated to the Board.

Communications relating to applicants are considered strictly confidential.

The Board of Direction will not consider the applications herein contained from residents of North America until the expiration of 30 days, and from non-residents of North America until the expiration of 90 days from the date of this list.

MINIMUM REQUIREMENTS FOR ADMISSION

GRADE	GENERAL REQUIREMENT	AGE	LENGTH OF ACTIVE PRACTICE	RESPONSIBLE CHARGE OF WORK
Member	Qualified to design as well as to direct important work	35 years	12 years	5 years RCM*
Associate Member	Qualified to direct work	27 years	8 years	1 year RCA*
Junior	Qualified for sub-professional work	20 years	4 years	
Affiliate	Qualified by scientific acquirements or practical experience to cooperate with engineers	35 years	12 years	5 years RCM*

* In the following list RCA (responsible charge—Associate Member standard) denotes years of responsible charge of work as principal or subordinate, and RCM (responsible charge—Member standard) denotes years of responsible charge of IMPORTANT work, i. e., work of considerable magnitude or considerable complexity.

APPLYING FOR MEMBER

ALTIERI, AUGUST FRANCIS, Washington, D.C. (Age 44) (Claims RCM 19.5) 1938 to date with PWA as Res. Engr. Inspector, and Regional Representative, Archt. Survey Comm.; previously in private practice of civil and construction engineering.

ASHTON, EDWARD (NED) LOWELL (Assoc. M.), Kansas City, Mo. (Age 37) (Claims RCA 4.1 RCM 7.0) July 1926 to July 1929 Tracer, Detailer, Designer, Checker, and Asst. Res. Engr., and Aug. 1935 to date Chf. Designer, Harrington, Howard & Ash, and/or Ash, Howard, Needles & Tammen.

BARLOW, DEWITT DUKES (Assoc. M.), New York City. (Age 59) (Claims RCA 3.0 RCM 34.1) Jan. 1904 to date with Atlantic, Gulf & Pacific Co., as Res. Engr., Office Engr., Secy., Treas., Vice-Pres., Gen. Mgr., and (since Feb. 1921) Pres. of Co. and affiliated companies.

BERGLUND, GUSTAF ERIC (Assoc. M.), Chicago, Ill. (Age 47) (Claims RCA 6.1 RCM 10.0) Sept. 1925 to Jan. 1933 and Jan. 1934 to date with The San. Dist. of Chicago as Structural Designer, and (since Jan. 1934) Asst. Civ. Engr.; in the interim in private practice.

BESOZZI, LEO (Assoc. M.), Hammond, Ind. (Age 37) (Claims RCA 5.0 RCM 5.1) Jan. 1938 to date in private practice; also, Oct. 1938 to date Engr. Member, Board of San. Commrs., Hammond; previously on study and report for PWA and later Designing Engr. for Board of Water-Works Trustee on 20-mgd water-filtration plant.

BROWNSON, VICTOR CARLETON, Liberty, N.Y. (Age 48) (Claims RCA 6.6 RCM 16.7) March 1922 to June 1925, April 1928 to April 1934, and Sept. 1935 to date with New York City Board of Water Supply as Sec. Engr., Senior Sec. Engr., Asst. Engr., and (since March 1939) Div. Engr., Neversink Div.

CARTER, HARRY VERN (Assoc. M.), Tulsa, Okla. (Age 53) (Claims RC 13.6 D 9.7) Jan. 1937 to date with Tulsa (Okla.) Boiler & Machinery Co., as Contr. Engr., Designer, and (since Jan. 1939) Sales Mgr., Structural Div.; previously with Star Manufacturing Co., Oklahoma City, Okla., and Muskogee (Okla.) Iron Works.

CLARK, ROBERT WILLIAM, Windsor, Conn. (Age 51) (Claims RCA 8.0 RCM 16.1) Oct. 1937 to Nov. 1939 Budget Examiner, Engr., Dept. of Finance and Control, and Nov. 1939 to date Highway Budget Examiner, Highway Dept., State of Connecticut; previously Area Constr. Engr. and Administrative Asst., U.S. Dept. of Agriculture; Senior Staff Member, Public Administration Service, Chicago, Ill.

DAVE, JOSEPH (Assoc. M.), Asheville, N.C. (Age 42) (Claims RCA 4.0 RCM 11.2) 1929 to date owner and Gen. Mgr., Dave Steel Co., designers, fabricators, and erectors of structural steel for buildings and bridges.

HAWLEY, HARRY HOLMAN (Assoc. M.), Chillicothe, Ohio. (Age 41) (Claims RCA 2.4 RCM 5.8) June 1925 to date with State Dept. of Highways, as Asst. Designing Engr., Designing Engr., Traveling Field Engr., and (since May 1939) Engr., Bureau of Constr.

HEALD, HENRY TOWNLEY (Assoc. M.), Chicago, Ill. (Age 35) (Claims RCA 0.5 RCM 13.6) Sept. 1927 to date at Armour Inst. of Technology as Asst. Prof., Associate Prof., and Prof., of Civ. Eng., Dean, Acting Pres., and (since May 1938) Pres. of Inst.

HIGGINS, THEODORE RUNDLETT, New York City. (Age 41) (Claims RCA 2.4 RCM 9.4) Jan. 1940 to date with American Inst. of Steel Constr.; previously Chf. Engr., New England Structural Co., Everett, Mass.

HODGES, PAUL VINCENT, Denver, Colo. (Age 56) (Claims RCA 3.6 RCM 18.1) July 1931 to date with U.S. Indian Irrigation Service, as Project Mgr., Asst. Production Coordinating Officer and Associate Engr., and since July 1937 Hydrographic Engr.

KEELOR, DON PIATT, Pittsburgh, Pa. (Age 33) (Claims RCA 0.4 RCM 19.8) May 1913 to April 1915 and June 1925 to date with U.S. Engr. Dept., as Inspector, Res. Engr., Asst. to Officer-in-Chg., Project Engr., and (since May 1936) Civilian Chf., Inspection Div.

KENNEDY, JAMES PHILLIP, Grand Forks, N.Dak. (Age 49) (Claims RCA 1.5 RCM 23.5) April 1933 to May 1937 and Jan. 1939 to date Div. Engr., North Dakota State Highway Dept.

MARSHALL, JAMES DAVIES, Kansas City, Mo. (Age 35) (Claims RCA 4.0 RCM 8.7) March 1930 to June 1938 Cons. Engr.; (since June 1938) also partner, Marshall & Brown, Archts. and Engrs., designing steel and concrete buildings.

PETTIT, HOMER BANISTER (Assoc. M.), Detroit, Mich. (Age 45) (Claims RC 22.5 D 8.5) Aug. 1917 to Aug. 1919 and Dec. 1920 to date with U.S. Army, War Dept., successively as 2d Lieut., 1st Lieut., Capt., and Major, Corps of Engrs.

POTTER, GRANT HAMBLETT (Assoc. M.), Providence, R.I. (Age 40) (Claims RCA 4.1 RCM 9.5) Feb. 1939 to date Chf. Engr. with C. A. Maguire & Associates; previously with FEA of PW as Res. Engr. Inspector, Engr., Acting Chf. Engr., and Senior Engr.

REDMAN, RUSSELL PAUL, Jacksonville, Fla. (Age 37) (Claims RCA 3.2 RCM 10.2) Nov. 1937 to date Vice-Pres., Aetna Steel Constr. Co.; previously Dist. Mgr., North American Constr. Co., Jacksonville, Fla.

ROACH, ALDEN GALLUP (Assoc. M.), Pasadena, Calif. (Age 38) (Claims RCA 4.5 RCM 12.1) Jan. 1929 to date with Consolidated Steel

LINCOLN

Nebraska

D. L. Erickson, Director, Department of Parks, Public Property and Improvements, Lincoln, Nebraska, writes:

"The cost of maintenance of our Ashland supply pipe line—25.1 miles of 36-inch cast iron pipe—has averaged $9.64 per mile per year for the last 5 years. I wish to reiterate that the maintenance cost record for this supply line shows that no money so far has been spent on the cast iron pipe or joints in the line."

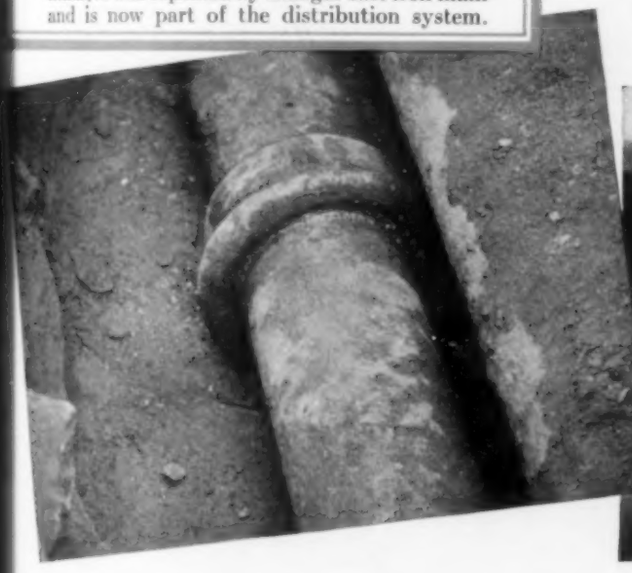
D. L. Erickson

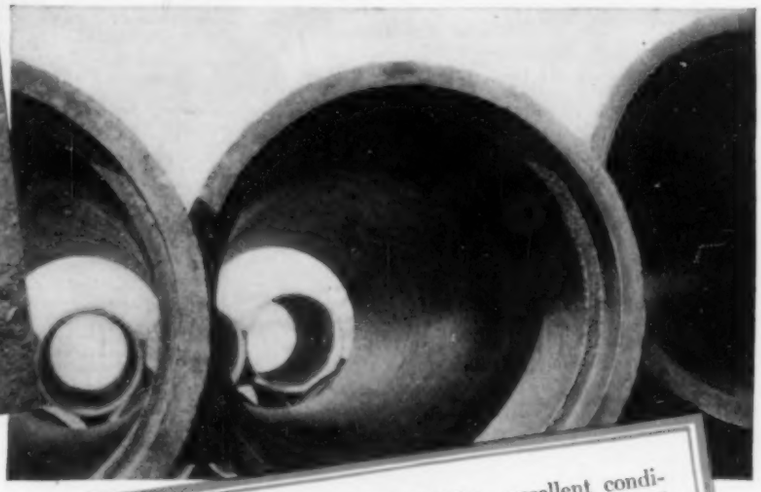
LOW MAINTENANCE

is an economy feature of cast iron pipe that is proved by water works records the nation over. An impartial survey among 195 water works superintendents shows that the maintenance cost of cast iron pipe is far below that of any other pipe material which has been in use long enough for the recording of conclusive data.

LONG LIFE

Unretouched photograph of America's second oldest cast iron water main still in service after 111 years in the water supply system of Lynchburg, Virginia. Originally a pumping main, it was replaced by a larger cast iron main and is now part of the distribution system.





SALVAGE VALUE Note excellent condition of this cast iron pipe, which was removed and cleaned for re-sale after a quarter-century of trouble-free service in the water distribution system of Dallas, Texas. Another instance of the salvage value of cast iron pipe.

Water mains represent about one-third of this country's 5-billion-dollar investment in public water supply systems. More than 98% of these mains are cast iron pipe with a *known* useful life at least double the *estimated* life of other water main materials. Because the tax-saving, through avoiding replacements, is enormous, cast iron pipe is known as Public Tax Saver No. 1.

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Corporation, Los Angeles, as Contr. Engr., Vice-Pres., and (since Oct. 1938) Executive Vice-Pres. and Director.

ROONEY, JAMES IGNATIUS (Assoc. M.), Jackson Heights, N.Y. (Age 42) (Claims RCA 4.7 RCM 8.0) July 1938 to date Asst. Engr., Board of Water Supply, New York City; previously Asst. Engr., New York City Tunnel Authority, Midtown Tunnel Project; Structural Steel Draftsman, Grade 4, Triborough Bridge Authority, New York City.

RUSSELL, WALTER CLAIR (Assoc. M.), Detroit, Mich. (Age 47) (Claims RCA 1.5 RCM 20.1) Jan. 1936 to date Vice-Pres. and Gen. Mgr., Peerless Cement Corporation; April 1922 to June 1928 Contr. partner with R. D. Baker, and June 1928 to July 1936 Pres., Robert D. Baker Constr. Co.; May 1933–Dec. 1935 also Receiver and Trustee, Peerless Cement Corporation.

SCHMID, ROBERT LYNDEN, Nashville, Tenn. (Age 53) (Claims RCA 6.0 RCM 13.0) Aug. 1915 to date with Nashville, Chattanooga & St. Louis R. R. as Pilot Engr., Asst. Engr., Asst. Track Engr., Asst. Div. Engr., Div. Engr., Asst. to Gen. Mgr., Prin. Asst. Engr., and (since Jan. 1940) Chf. Engr.

SCOTT, WARDNER GIBSON, Lincoln, Nebr. (Age 43) (Claims RCA 8.0 RCM 12.0) Jan. 1920 to date member of firm, Scott & Scott, Engrs.; also since Jan. 1927 Chf. Engr., San. Dist. No. 1 of Lancaster County, Nebr.

STRIEGL, ALBERT ROLLIN, Milwaukee, Wis. (Age 45) (Claims RCA 5.6 RCM 8.7) June 1921 to date with U.S. Engr. Office as Inspector, Jun. Engr., Asst. Engr., Associate Civ. Engr., and (since July 1931) Civ. Engr.

VAUGHAN, HENRY FRIEZE (Assoc. M.), Detroit, Mich. (Age 50) (Claims RC 21.1 D 2.3) Jan. 1919 to date Health Commr., Detroit Dept. of Health.

WHITE, HERBERT LEROY (Assoc. M.), Urbana, Ill. (Age 39) (Claims RCA 6.5 RCM 6.0) Jan. 1932 to date San. Engr., Physical Plant Dept., Univ. of Illinois.

WILLIAMSON, ARTHUR VAUGHN, Denver, Colo. (Age 56) (Claims RCA 7.3 RCM 21.3) June 1919 to date with U.S. Bureau of Public Roads and Public Roads Administration as Highway Engr., Senior Highway Engr.

APPLYING FOR ASSOCIATE MEMBER

ADAMS, LAWRENCE FREDRIC (Junior), St. George, S.I., N.Y. (Age 30) (Claims RCA 3.6 RCM 2.5) June 1937 to date Asst. Engr. Designer, Board of Water Supply, New York City; previously Asst. Engr., U.S. Engr. Office; Senior Engr., Essex County Riparian Survey; Foreman, National Park Service.

BAER, WILLARD ARTHUR (Junior), Little Rock, Ark. (Age 32) (Claims RCA 1.5) Dec. 1933 to date with U.S. Engrs., as Eng. Draftsman (Civ.), Senior Eng. Draftsman (Civ.), and (since May 1937) Jun. Engr. (Civ.).

BANKHEAD, JOSEPH HARDING, Moundsville, W. Va. (Age 34) (Claims RC 9.2 D 1.8) July 1927 to date with State Road Comm. of West Virginia as Inspector, Jun. Engr., Asst. Maintenance Engr., and (since Dec. 1937) Senior Engr. (Dist. Maintenance Engr.).

BARTON, EUGENE ANTHONY, Plainfield, N.J. (Age 29) (Claims RCA 5.1) April 1938 to date Safety Engr., National Conservation Bureau, New York City; previously with Walter Kidde & Co., Bloomfield, N.J., Calco Chemical Co., Bound Brook, N.J., and Designer, Davis Eng. Corporation, Elizabeth, N.J.

BENNETT, EARL ROBERT (Junior), Vallejo, Calif. (Age 31) (Claims RCA 3.8) June 1939 to date Senior Inspector, U.S. Navy Dept., Mare Island (Calif.) Navy Yard; previously with R. E. Millsap, Inc., Gen. Constrs. and Engrs., Los Angeles, Calif., Metropolitan Water Dist. of So. Calif.

BRENNAN, WILLIAM ANDERSON, White Plains, N.Y. (Age 45) (Claims RCA 12.0 RCM 2.2) Jan. 1926 to Dec. 1937 Deputy Commr., and Jan. 1938 to date Commr., of Public Safety.

CAMPBELL, MAXWELTON SELWYN (Junior), Seattle, Wash. (Age 32) (Claims RCA 4.5 RCM 1.8) April 1936 to date Asst. Public Health Engr., Div. of Public Health Eng., State Dept. of Health; previously County Engr., Whatcom County, Wash.; Engr., Whatcom County Engr's. Office, Bellingham, Wash.

CHAMBERLIN, STEPHEN JOHNES (Junior), Ames, Iowa. (Age 32) (Claims RCA 1.6) Sept. 1929–June 1931 and Aug. 1936 to date at Iowa State Coll., as Graduate Asst., Civ. Eng. Dept., Instructor, and (since Aug. 1938) Asst. Prof., Dept. of Theoretical and Applied Mechanics; also, Aug. 1936 to Aug. 1938 Jun. Materials Engr., and since Aug. 1938 Asst. Materials Engr., Iowa Eng. Experiment Station.

CRAWFORD, LAWRENCE C., Washington, D.C. (Age 33) (Claims RCA 4.2) July 1930 to date with U.S. Geological Survey, Dept. of Interior, as Jun. Hydr. Engr., Asst. Hydr. Engr., and (since Aug. 1938) Asst. and Associate Hydr. Engr.

CRAWSHAW, ARTHUR CLYDE, San Francisco, Calif. (Age 41) (Claims RCA 2.1 RCM 0.8) Jan. to April 1938 and Aug. 1939 to date Civ. Eng. Draftsman, City of San Francisco; May 1938 to July 1939 Computer and Quantity Engr., Consolidated Builders, Inc., Grand Coulee Dam; previously with Archt. and Eng. Div., RA and FSA, San Francisco, and with U.S. National Park Service.

CRAWSHAW, HARRIS VERNON, North Hollywood, Calif. (Age 36) (Claims RCA 9.6) Jan. 1930 to date with Metropolitan Water Dist. of So. California, as Transitman, Levelman and Chf. of Party, and (since May 1931) Asst. Engr.

CUSHING, ROBERT MILNER, Phoenix, Ariz. (Age 35) (Claims RCA 5.5 RCM 0.2) Nov. 1933 to March 1934 Field Engr., July 1934 to July 1935 and Sept. 1935 to date Asst. Engr., Headman, Ferguson & Carollo; in the interim with U.S. Indian Irrigation Service, The Arizona Power Co. and NYA.

ELLIOTT, DONALD SAGER, New Orleans, La. (Age 29) (Claims RCA 2.4) Dec. 1937 to date Engr., Texas Pacific-Missouri Pacific Terminal R. R.; previously with Willacy County Water Control and Improvement Dist. 1, Raymondville, Tex., Colorado River Authority, Buchanan Dam, Tex., Texas State Highway Dept., Div. 14, and Gurley Constr. Co., Inc., Fort Worth.

FRIEDLAENDER, HERMANN (Junior), Tacoma, Wash. (Age 32) (Claims RCA 2.3) Sept. 1937 to date Bridge Designer, successively in County Engr.'s Office, Seattle, Wash., with City of Tacoma, and (since Jan. 1939) with Washington Toll Bridge Authority, Olympia, Wash.; previously Engr., Chicago (Ill.) Bridge & Iron Co.; Detailer, Boeing Aircraft Co., Seattle, Wash.

GARDNER, ROBERT ANTHONY (Junior), Harrisburg, Pa. (Age 32) (Claims RCA 13.7 RCM 0.5) Aug. 1939 to date Hydr. Engr., Bureau of Encroachments, State Dept. of Forests and Waters; previously Instructor and Asst. Prof., Bucknell Univ., Lewisburg, Pa.

GILBERT, JOSEPH JENKINS (Junior), Abington, Pa. (Age 32) (Claims RCA 1.0 RCM 6.4) May 1934 to date San. Engr. for 12 southern states, in charge of sewage, water, and industrial waste-treatment plant design for use of link belt equipment.

HANSON, IVAN PHILIP, Natchez, Miss. (Age 37) (Claims RCA 5.4 RCM 7.7) Feb. 1939 to date Res. Engr., Ash-Howard-Needles & Tammen; previously Senior Rodman, Los Angeles Div., Southern Pacific Co.; Office Mgr., Cost Accountant, Watchman, Timekeeper, Inspector, Res. Engr., and Asst. Supt., Missouri Valley Bridge and Iron Co.

HAVEN, ROBERT COOPER, JR. (Junior), Salt Lake City, Utah. (Age 32) (Claims RCA 4.1) Sept. 1933 to date with U.S. Bureau of Reclamation as Jun. Engr., and (since Feb. 1939) Asst. Engr., Div. of Project Investigations.

HAY, JOHN LEONARD, Santa Fe, N.Mex. (Age 34) (Claims RC 4.0 D 3.0) April 1930 to date with New Mexico Power Co., as Draftsman and (since Jan. 1933) Engr., having charge of Eng. Dept. in absence of Supt.

HESELTON, FRANK RICHMOND, York, Pa. (Age 27) (Claims RCA 1.3) April to Nov. 1936 and Sept. 1938 to date with U.S. Engr. Office as Recorder, Draftsman, and (since July 1939) Jun. Engr.; in the interim Bldg. Inspector, Boston Woven Hose & Rubber Co., Cambridge, Mass.

HOAR, VICTOR MYERS, Washington, D.C. (Age 33) (Claims RC 3.2) Nov. 1938 to date Asst. Engrl Federal Power Comm.; previously with U.S. Engrs., War Dept., as Asst. Draftsman, and Jun. Engr.

HUEBNER, JOHN BRADY (Junior), Little Rock, Ark. (Age 32) (Claims RCA 2.0) May 1928 to Sept. 1929, summer 1930 and Feb. 1931 to date with U.S. Engrs., Memphis and Little Rock Dists., as Surveyman, Chf. of Party and (since July 1937) Jun. Engr. and Asst. Engr.

IPPEN, ARTHUR THOMAS (Junior), Bethelehem, Pa. (Age 32) (Claims RCA 2.9 RCM 0.5) Sept. 1938 to date at Lehigh Univ., as Instructor in Civ. Eng., and (since Sept. 1939) Asst. Prof. of Civ. Eng.; previously at California Inst. of Technology as Teaching Fellow and Research Asst., Hydraulics Dept., Research Fellow and Instructor in Mech. Eng. Dept. and Hydr. Structures Laboratory.

JENSEN, GEORGE ALVIN, Central Valley, Calif. (Age 30) (Claims RCA 0.6 RCM 1.3) Nov. 1939 to date Draftsman, Columbia Constr. Co., Redding, Calif.; previously with WPA as Chf. of Party and Field Engr.; previously Estimator and on cost accounting with Vance Brown, Gen. Contr., Palo Alto, Calif.; with California State Highway Dept. as Rodman, Chainman, Levelman, Grading Inspector, Instrumentman, Chf. of Party, Inspector and Asst. Res. Engr.

JONES, JAMES ALLEN (Junior), Cleveland, Miss. (Age 31) (Claims RCA 3.2) April 1938 to date City Engr.; previously Constr. Supt., WPA, Greenville, Miss.; Engr. and Estimator, Chas. Weaver Co., Inc., Jackson, Miss.; private practice, surveys and mapping in Sunflower County.

KEAVENY, FELIX JAMES, New York City. (Age 36) (Claims RCA 0.9 RCM 2.6) Oct. 1938 to date Asst. Engr. with Controller, New York City; previously Structural Designer, successively with The Panama Canal, Balboa Heights, Canal Zone, and Grade 4, Tunnel Authority; Structural Draftsman, Standard Oil Co., Elizabeth, N.J., and Madigan-Hyland; Senior Draftsman, Dept. of Parks, New York City; Computer, U.S. Coast and Geodetic Survey, New York City.

KINZER, HUGH ROBINSON, Hiwassee Dam, N.C. (Age 38) (Claims RCA 11.1) April 1932 to date with U.S. Engrs., as Field Engr. (Inspector), Computer, Asst. Structural Engr., and (since July 1937) Associate Civ. Engr., Constr. Engr.'s Office.

KITE, MAURICE BURTON (Junior), Chattanooga, Tenn. (Age 30) (Claims RCA 2.4) July 1933 to date with TVA as Jun. Eng. Aide, Senior Eng. Aide, Prin. Eng. Aide, and (since Sept. 1937) Asst. Structural Engr.

KUSHING, JOHN WESLEY, Lansing, Mich. (Age 39) (Claims RC 6.6) 1933 to 1937 and Aug. 1939 to date with Michigan State Highway Dept., as Research and Testing Engr., and (since Aug. 1939) Research Engr.; in the interim Vice-Pres. in charge of Eng., Highway Steel Products Co., Chicago Heights, Ill.

LANE, EDWARD NEIL WILTAMUTH (Junior), Phoebus, Va. (Age 31) (Claims RCA 4.9) Jan. 1940 to date Jun. Civ. Engr., National Advisory Comm. for Aeronautics, Langley Field, Va.; Nov. 1938 to Jan. 1940 Jun. Civ. Engr., National Park Service, Omaha, Nebr.; previously Rodman and Instrumentman, Dept. of Roads and Irrigation, Lincoln.

LEWIN, HAROLD ANDREW (Junior), Yonkers, N.Y. (Age 32) (Claims RCA 2.6 RCM 2.5) July 1930 to Feb. 1933 and Jan. 1937 to date with Board of Water Supply, New York City as Eng. Asst., and (since Jan. 1937) Asst. Sec. Engr.; with PWA, U.S. Coast and Geodetic Survey, and CWA.

MCGILVRA, ROBERT DICKINSON (Junior), Wildwood, N.J. (Age 29) (Claims RCA 2.2) Dec. 1938 to date Res. Engr., Ash-Howard-Needles & Tammen; previously Instrumentman, etc., Robinson & Steinman; Civ. Engr., Works Inspection Dept., Western Elec. Co., Kearny, N.J.; Res. Engr., City of Bend, Ore.; Tracer, Inspector, and Office Engr., Oregon State Highway Comm.

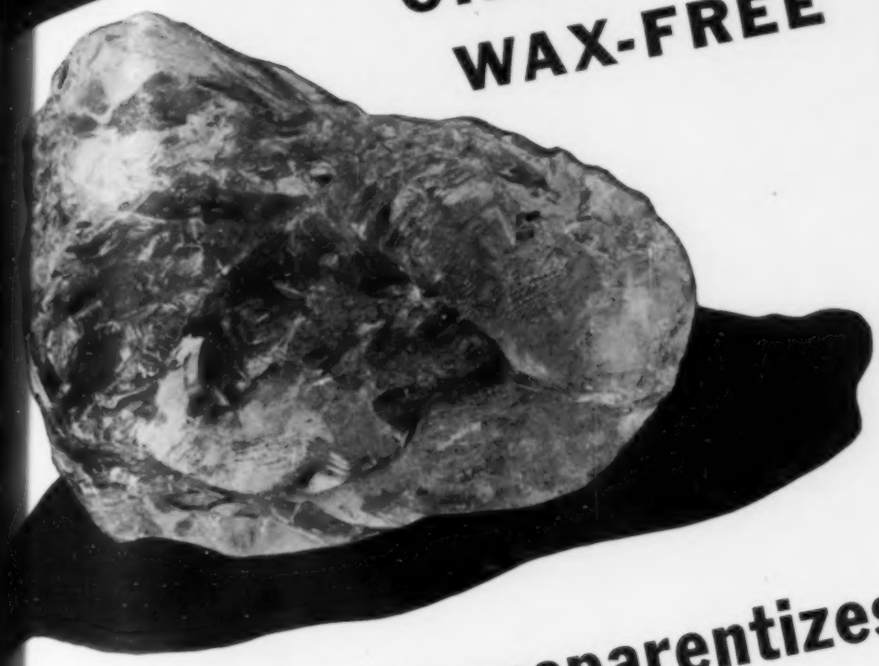
MARANE, ALFRED CARL (Junior), Spring City, Tenn. (Age 32) (Claims RCA 3.2) Dec. 1939 to date Asst. Structural Engr., Watts Bar Dam; previously Senior Eng. Draftsman, Prin. Eng. Draftsman, and Asst. Structural Engr., Chickamauga Dam, Chattanooga, Tenn.; Eng. Draftsman, successively with Picatinny Arsenal, Dover, N.J., and TVA, Chattanooga.

MILNER, WALKER WILSON (Junior), West Point, N.Y. (Age 32) (Claims RCA 4.1) 1st Lieut, C.E., U.S. Army; July 1937 to date Instructor, Dept. of Mathematics, U.S. Military Acad.; previously with 3d Engrs., Schofield Barracks, Hawaii.

MULLESTEIN, WILLIAM ERNEST, New York City. (Age 28) (Claims RCA 4.8) Oct. 1939 to date with American Iron & Steel Inst., assisting in review of building codes and drafting recommendations for standardization of codes throughout country; previously Supt., Kalman Floor Co.; Eng. Asst. with Borough Pres. of Manhattan; Engr., The Austin Co.; Asst. to Patent Attorney, Austin & Dix.

NERDAHL, LOYAL MELVIN (Junior), Lake Mohonk, N.Y. (Age 30) (Claims RCA 5.6) April 1938 to date Maintenance Engr., Lake Mohonk Mountain House; Nov. 1933 to July 1937 with U.S. Dept. of Interior, ECW.

NUZUM, CHARLES RICHARD (Junior), Keyser, W.Va. (Age 32) (Claims RCA 3.6) June 1929 to Jan. 1930, June 1930 to Sept. 1931, and June 1932 to date with State Road Comm. as Draftsman, Inspector, Asst. to Dist. Engr., and (since Jan. 1938) Res. Engr., Dist. 5.



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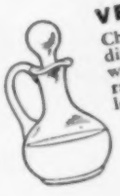

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PANUZIO, FRANK LOUIS (Junior), Bridgeport, Conn. (Age 32) (Claims RCA 4.0) Nov. 1936 to date Asst. and Associate Hydr. Engr., U.S. Engr. Office, New York Dist.; previously Jun. and Asst. Hydr. Engr., U.S. Bureau of Reclamation, Denver, Colo.

PEARSON, EDWARD RUSSELL (Junior), Galveston, Tex. (Age 32) (Claims RCM 3.5) May 1929 to date with U.S. Engr. Office as Inspector, Jun. Engr., and at present Asst. Engr.

PEREZ, LAWRENCE, West New Brighton, N.Y. (Age 32) (Claims RCA 6.4) Sept. 1929 to date Instructor, Civ. Eng. Dept., Cooper Union, also since Sept. 1930 associated with Stillman & Van Siclen, Inc., New York City.

PETERSON, PAUL GILBERT, Chicago, Ill. (Age 34) (Claims RCA 3.3) May 1934 to date with Fabricated Steel Div., Bethlehem Steel Co.

PHILLIPPI, STANLEY, Albuquerque, N.Mex. (Age 39) (Claims RC 8.8 D 2.0) Oct. 1926 to date with Middle Rio Grande Conservancy Dist., as Asst. Engr., Asst. Chf. Engr., and (since July 1939) Acting Chf. Engr. in charge of all work of Dist.

POLI, THOMAS (Junior), New York City. (Age 32) (Claims RCA 6.7) Oct. 1935 to date with Dept. of Hospitals, New York City, as Asst. Engr., Field Engr., Head Designer, Squad Chf., Design Unit, Civ. Eng. Sec.; previously with Port of New York Authority (under CWA).

QUIRIN, EDWARD JOSEPH (Junior), Woodside, N.Y. (Age 28) (Claims RCA 3.4) March 1939 to date Chf. Draftsman, F. R. Harris, Inc., Cons. Engr., New York City; previously Structural Engr. and Draftsman with Madigan-Hyland, Cons. Engrs.; Structural Engr., successively with Mayers, Murray & Phillip, Archts., and E. H. Praeger, Cons. Engr.

SAWYER, LEON RANDOLPH (Junior), Denver, Colo. (Age 32) (Claims RCA 3.7) Sept. 1930 to date with Water Resources Branch, U.S. Geological Survey as Jun. Hydr. Engr., and (since May 1936) Asst. Hydr. Engr.

SIMPSON, KENNETH, South Gate, Calif. (Age 31) (Claims RCA 9.4) Sept. 1936 to date Eng. Salesman for Garlinghouse Brothers, Los Angeles, Calif.; previously Shift Foreman, Broderick & Gordon; Res. Inspector, Eagle Mountain Tunnel.

SMITH, HESTER MOORE, San Antonio, Tex. (Age 41) (Claims RCA 10.4 RCM 1.3) April 1938 to date Dist. Airport Engr., Bureau of Air Commerce and Civ. Aeronautics Authority for Texas and New Mexico; previously Airport Engr., WPA and Aviation Comm. of Alabama; Concrete Inspector, TVA.

VAN HORN, EMERY LAMARTINE, Binghamton, N.Y. (Age 32) (Claims RCA 4.5) Sept. 1931 to date with U.S. Engr. Office as Surveyman, Jun. Engr.

VIDELA, CARLOS CORTI, La Plata, Argentina, S.A. (Age 48) (Claims RCA 11.1) Dec. 1937 to date with Province of Buenos Aires on cadastral survey as Chf. Engr., and (since Feb. 1939) Gen. Inspector Engr.; May 1931 to Oct. 1937 with Province of Mendoza, successively as Inspector Engr., Southern Zone of Public Roads, Gen. Director in charge of Public Works Dept., Gen. Director of Vialidad, and (after March 1935) in charge of Topographical Dept.

WARDEN, MAXWELL RINEHARDT, Wilmington, Del. (Age 37) (Claims RCA 13.4) Oct. 1926 to date with E. I. du Pont de Nemours & Co., as Asst. Constr. Supt., Constr. Supt., Gen. Foreman, Area Engr., Engr., and (since July 1937) Special Asst. to Mgr., Constr. Div., Eng. Dept.

WOOLLEY, LOGAN HOWARD (Junior), Omaha, Nebr. (Age 32) (Claims RCA 2.7) June to July 1930, Aug. 1931 to April 1932, Nov. to Dec. 1932, and March 1933 to date with U.S. Engr. Office as Topographical Draftsman, Surveyman, Jun. Draftsman, Laborer, Subinspector, Instrumentman, Civ. Eng. Draftsman, Jun. Civ. Engr., Asst. Civ. Engr., and (since May 1938) Asst. Civ. Engr. and Associate Civ. Engr., Design and Survey Sec.

APPLYING FOR JUNIOR

AUTILIO, ALADINO ALFONSO, JR., Pittsburgh, Pa. (Age 27) (Claims RCA 1.2) Dec. 1936 to May 1937 and Nov. 1938 to date Jun. Engr., U.S. Engr. Dept.; in the interim successively Inspector with Pennsylvania R.R., and Standard Oil Co. of Pennsylvania; previously Structural Draftsman, Board of Education, Philadelphia.

BOES, GLENN HAROLD, Randolph Field, Tex. (Age 22) 1939 B.S. in Civ. Eng., Kans. State Coll.; Aug. 1939 to date Flying Cadet, U.S. Army Air Corps.

BRAUNSTEIN, ALFRED HILLEL, Pittsburgh, Pa. (Age 27) (Claims RCA 1.3) Aug. 1936 to date with U.S. Engr. Office, War Dept., as Rodman, Chainman, and (since Dec. 1936) Jun. Civ. Engr.; previously Chainman also acting as Rodman, Pennsylvania Dept. of Highways.

BRILL, ROYSE HARLAN, Bozeman, Mont. (Age 30) (Claims RCA 1.0) Oct. 1939 to date (spare time) Cons. Engr., Mount Haggin Land and Livestock Co. of Anaconda, Mont.; since Jan. 1940 also student, Montana State Coll.; previously with FWA, PWA, Omaha, Nebr., Montana Power Co., Butte, Mont., Bureau of Reclamation, CCC, Denver, Colo., Phoenix Eng. Corporation, New York City, and National Park Service, CCC, Morrison Cave State Park, Cardwell, Mont.

BRODBECK, ERNEST EDWARD, Pittsburgh, Pa. (Age 23) 1938 B.C.E., Brooklyn Pol. Inst.; Nov. 1939 to date Jun. Engr., U.S. Army Engrs.

BURGESS, LLOYD ALBERT, Portland, Ore. (Age 22) 1939 completed requirements for degree of B.S. in Eng., Ore. State Coll. (degree to be conferred in June 1940); June 1939 to date Engr. Aide with U.S. Engrs., War Dept., acting as Jun. Engr.

CROSBY, HEWITT, JR., Washington, D.C. (Age 22) 1939 B.S. in C.E., Purdue Univ.; Sept. 1939 to date Timekeeper, Corson & Gruman, Contrs., Washington, D.C.

CROW, STEVEN GLENBURN, San Jose, Calif. (Age 27) 1938 B.S. in Civ. Eng., Univ. of Calif.; Aug. 1936 to Aug. 1937 and May 1938 to date with State Div. of Highways as Jun. Eng. Aide, Dist. VI, and Senior Eng. Aide, Dist. IV.

DORNEMANN, FREDERICK HENRY, Hiwassee Dam, N.C. (Age 29) 1935 B.S. in Civ. Eng., Pa. State Coll.; Aug. 1935 to date with TVA as Eng. Draftsman, Office Asst. to Field Engr., and (since June 1937) Jun. Civ. Engr.

EMERY, JAMES ALBERT, JR., New York City (Age 24) 1938 S.B., Mass. Inst. Tech.; July 1938 to date with American Transit Association as accident Research Asst., and (since July 1939) Asst. to Eng. Secy.

FORD, DWAYAIN KEENE, Seattle, Wash. (Age 28) July 1936 to May 1939 Topographic Draftsman, and May 1939 to date Senior Civ. Eng. Aide, U.S. Engr. Dept.; previously Eng. Draftsman, U.S. Bureau of Public Roads.

FRANKFURTER, DAVID ROY, Seattle, Wash. (Age 22) 1939 B.S. in C.E., Univ. of Wash.

HAMBLIN, CLIFFORD WILLIAM, Huntington, W. Va. (Age 30) (Claims RCA 0.5) Feb. 1937 to date Jun. Engr., U.S. Engr. Office; previously Eng. Aide, U.S. Soil Conservation Service, Maquoketa, Iowa; Eng. Foreman, U.S. Forest Service, Chariton, Iowa.

HARRIS, JOHN FRANCIS, Racine, Wis. (Age 22) 1939 B.C.E., Marquette Univ.; Sept. 1937 to date with Racine Water Dept. as Jun. Engr., and (since June 1939) Engr.

HENDRICKS, ERNEST LEROY, Ocala, Fla. (Age 30) (Claims RCA 2.8) April 1935 to Aug. 1938 Jun. Hydr. Engr., and Aug. 1938 to date Asst. Hydr. Engr., U.S. Geological Survey, Water Resources Branch, Surface Waters Div.

HIPPEY, FREDERICK ALLEN, Richmond, Va. (Age 22) 1939 B.S. in C.E., Va. Mil. Inst.; Oct. 1939 to date with Virginia State Highway Dept. as Senior Highway Engr. Draftsman and Prin. Materials Engr. Aide.

JENNER, LESLIE CHARLES, Seattle, Wash. (Age 25) 1939 B.S. in C.E., Univ. of Wash.

JESPERSEN, KARL GEORGE, Brooklyn, N.Y. (Age 24) Jan. 1940 to date with Ambursen Constr. Co.; previously with Bureau of Power and Light, Los Angeles, Michigan Dept. of Health, Shoecraft, Drury & McNamee, Ford Motor Co., etc.

LANG, ROLLAND FRANCIS, Brookings, S.Dak. (Age 25) 1937 B.S. in C.E., S. Dak. State Coll. of Agri. & Mech. Arts; June 1937 to date Instructor in Civ. Eng., South Dakota State Coll.

LANKFORD, LEONARD AVERA, Dallas, Tex. (Age 27) (Claims RCA 1.1) July 1937 to date with Dallas County Health Dept., as Sanitarian and (since Feb. 1938) San. Engr.; previously Graduate Asst., Mun. and San. Eng. Dept., Texas Agricultural & Mechanical College; Asst. to D. C. Walmsley of Walmsley & Frierson, Engrs.

LI, EU-DIEN, Madison, Wis. (Age 28) (Claims RC 0.5) 1935 B.S. in Civ.Eng., St. John's Univ., Shanghai, China. 1939 M.S. in Civ.Eng., Univ. of Wis.; Sept. 1937 to date graduate student, Univ. of Wisconsin; since Sept. 1939 on research work in Structural Eng. Dept.

MAIER, FRANZ JOSEPH, Jackson Heights, N.Y. (Age 30) (Claims RCA 3.5) April 1932 to Nov. 1935 and Sept. 1936 to date with U.S. Public Health Service as Attendant, and (since Sept. 1936) Asst. Public Health Engr.; in the interim Asst. to Chf. Engr., Oliver United Filters, Inc.

MAIER, JOSEPH WILLIAM, Pittsburgh, Pa. (Age 27) Oct. 1939 to date Jun. Engr., U.S. Engr. Office; previously Eng. Aide, Federal Power Comm., Div. of Power, Washington, D.C.; Highway Engr., WPA Project 1071, Philadelphia, Pa.

MEESE, RICHARD HUNT, Seattle, Wash. (Age 22) 1939 B.S. in C.E., Univ. of Wash.; at present Bookkeeper and Estimator, Bay Construction Inc.

MORCH, JOHN VALDEMAR, Allentown, Pa. (Age 25) 1938 B.Sc. in Civ.Eng., Royal Tech. Coll., Copenhagen, Denmark; Feb. 1939 to date Engr., E. C. Machin Co., on design of reinforced concrete structures; May to Oct. 1938 with The Danish Army; Feb. to May 1938 Asst. Engr., Copenhagen Harbor Authority.

MORTENSEN, CARL JULIUS, Oakland, Calif. (Age 28) Sept. 1939 to date Inspector, U.S. Engr. Dept.; previously Asst. to Mining Engr. in study and survey of possible gold-mine sites; with San Francisco Bay Exposition Co., U.S. Bureau of Reclamation, and California Div. of Highways.

MUNGER, HARRIS BRENNER, JR., Modesto, Calif. (Age 25) 1939 completed requirements for degree of B.S. in C.E., Univ. of Calif. (degree to be conferred in May 1940).

OGLESBY, HENRY RUBE, JR., Kansas City, Kans. (Age 25) 1938 B.S. in C.E., Ga. School Tech.; May 1938 to date with U.S. Engrs., War Dept., as Inspector, Jun. Engr. (Civ.), Inspector, and (since Aug. 1939) Eng. Aid (Civ.).

PECK, ROBERT HILLES, Pittsburgh, Pa. (Age 25) 1937 B.S. in C.E., Univ. of N.C.; Oct. 1939 to date Jun. Engr., U.S. Army Engrs.

PHILLIPS, ROBERT VAN NESS, Los Angeles, Calif. (Age 22) 1939 completed requirements for degree of B.S. in C.E., Univ. of Calif. (degree to be conferred in May 1940).

POPE, ROBERT JOHN, Park Place, Ore. (Age 25) 1939 B.S. in C.E., Univ. of Wash.

PYZDROWSKI, STANLEY SIGISMUND, Pittsburgh, Pa. (Age 23) 1938 B.S., Univ. of Pittsburgh. Aug. 1938 to date Asst. Supt. or Supt. with his father, a gen. contr., on erection of schools, churches, etc.

RIMMER, JAMES STEPHEN, University Park, Md. (Age 24) 1936 B.S. in Civ.Eng., Univ. of Md. 1939 M.S. in Civ. Eng., Ga. School Tech.; June 1936 to June 1937 and Aug. 1939 to date Line and Grade Man, Constr. Dept., Washington Suburban San. Comm., Hyattsville, Md.

ROBINSON, WILLIAM HAROLD, Seattle, Wash. (Age 24) 1939 B.S. in C.E., Univ of Wash.

SEIPT, HENRY MAXIMILLIAN, JR., San Angelo, Tex. (Age 25) 1939 B.S. in Civ. Eng., Univ. of Wyo.; June 1939 to date with U.S. Bureau of Reclamation.

SMITH, ROBERT WAKEFIELD, Santa Paula, Calif. (Age 26) (Claims RC 3.2 D 0.7) Feb. 1935 to date with U.S. Dept. of Agriculture, SCS, as Eng. Trainee, Jun. Engr. Aide, Jun. Agri. Engr., and (at present) Asst. Agri. Engr.

SPHAR, LELAND LAWRENCE, Columbus, Ohio. (Age 27) (Claims RCA 1.8) Nov. 1938 to date Jun. Engr., U.S. Geological Survey, Water Resources Branch; previously with Gilbert-Varker, Inc., Donora Southern R. R. Co., American Steel & Wire Co., and Donora Constr. Co.

STEPHENS, JOHN FIKE, Kings Park, N.Y. (Age 24) 1937 C.E., Cornell Univ.; July 1939 to date Timekeeper, Turner Constr. Co.; previously Technical Aid in Geophysical Investigation; Asst., Eng. Corps, M. of W. Dept., Pennsylvania R.R.

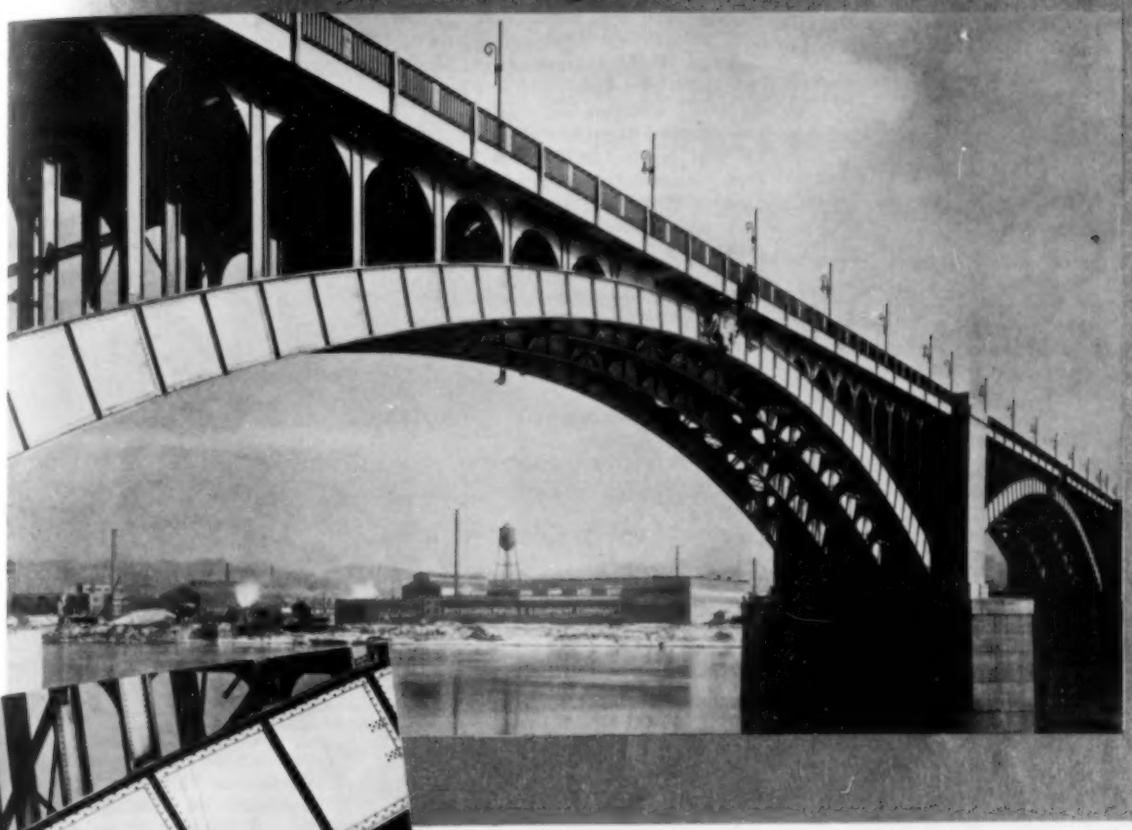
STERN, ERNEST GEORGE, State College, Pa. (Age 27) (Claims RC 1.6) 1936 to date at Pennsylvania State Coll., as Graduate Asst., Eng. Experiment Station, Architect, Designer, and Draftsman with Dean E. Kennedy, W. Pope Barney, etc., and (since 1938) Research Asst., Eng. Experiment Station.

STUBBLEFIELD, WILLIAM MAXWELL, Berkeley, Calif. (Age 21) 1939 completed requirements for degree of B.S. in C.E., Univ. of Calif. (degree to be conferred in May 1940).

TATARIAN, S. MYRON, San Francisco, Calif. (Age 22) 1939 completed requirements for degree of B.S. in C.E., Univ. of Calif. (degree to be conferred in May 1940).

The Board of Direction will consider the applications in this list not less than thirty days after the date of issue.

HAVE YOU EVER HAD PAINT *last 10 years?*



LASTED 10 YEARS. The Washington Crossing Bridge, Pittsburgh, painted with two coats of Aluminum Paint, over rust-inhibitive primer and field coats, on completion in 1924. Inset shows close-up of paint 9 years later. When repainted in 1935, the original Aluminum Paint was still in good condition.

Ten years is a long time for paint to last. Here's one case where Aluminum Paint did just that. If ever there was proof that you get longer protection with Aluminum Paint, this bridge is it.

Combine long life with low cost per gallon and you can readily understand why Aluminum Paint has won such great favor with bridge engineers and highway departments. It makes money go farther.

Add to that, attractive appearance which beautifies bridges and light reflectivity that makes bridges safer for night driving. There you have four potent reasons for standardizing on Aluminum Paint for your bridges.

Should you desire more specific data on any of these reasons, or wish recommendations on painting problems, write ALUMINUM COMPANY OF AMERICA, 1918 Gulf Building, Pittsburgh, Penna.

ALCOA

ALBRON *Paste for*

**We make Aluminum Pigments only: no Aluminum Paint. Buy your Aluminum Paint from leading paint manufacturers who use Alcoa Albron Paste.*

ALUMINUM PAINT

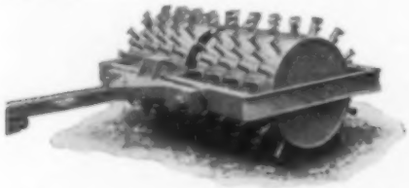
for ECONOMY • BEAUTY • SAFETY • PROTECTION

Equipment, Materials, and Methods

New Developments of Interest, as Reported by Manufacturers

Bucyrus-Erie Tamping Rollers and Rippers

RIPPERS AND TAMPING rollers are new tractor equipment items recently placed on the market by Bucyrus-Erie Company, South Milwaukee, Wis.



The new Bucyrus-Erie Tamping Rollers are offered in single, double, or triple drum models, with 72, 96, or 112 feet per drum available in each model. All rollers have rear pull connections for working in trains, and all drums are provided with openings for ballast. Double and triple drum models have oscillating drums which permit the rollers to adapt themselves to uneven ground surfaces. The tamping feet are renewable. When worn, they are easily removed and easily replaced with new feet.

The new rippers are of two types, the rotary type and the heavy duty cable-operated type. Outstanding feature of the rotary type ripper is a rotating head, which swings the ripping standards up and back and around to ripping position again quickly. This quick raising and lowering of standards makes the Bucyrus-Erie Rotary Ripper especially effective for work in material containing boulders and heavy roots. Complete rotation of the head also dislodges rocks and debris caught between the standards and prevents the ripper from picking up the same debris again. Since power to rotate the head is derived solely from the pull of the tractor drawbar, the rotary ripper can be used with hydraulic controls or with tractors having no auxiliary power equipment.

The cable-operated ripper is a heavy duty ripping tool for breaking up exceptionally hard-digging hard-loading materials such as shale, hardpan, decomposed granite, sandstone, old macadam, etc. Controlled by a cable operated from the tractor winch, the standards on this ripper can penetrate full length below ground level, 17 in. on Model Cr-1 and 24 in. on Model CR-2. The standards can also be set at any intermediate point or raised above ground for traveling. To add to the life of the ripper, the self-sharpening points are renewable and can be easily replaced as they become worn.

Many other features of these new rippers and tamping rollers are described in bulletins available from the manufacturer.

New Northwest Crane

A NEW CRANE, primarily designed for handling and setting steel, handling piling, setting stone, etc., has been announced by The Northwest Engineering Co. of Chicago, Ill. It is known as the Model 71, is crawler mounted, and has a capacity of 40 tons. Extreme versatility as to boom position and line control is made available by four drums, including a worm boom hoist; a combination which is reported to care for any steel setting job.

A special folding gantry that can be lowered provides ample overhead clearance when traveling under obstructions. All Northwest features, the "Feather-Touch" clutch control, the cushion clutch, the helical gear drive, ball or roller bearings on all high speed shafts, uniform pressure swing clutches, and steering with positive traction on both crawlers while turning as well as when going straight ahead, are standard equipment.

Marion Builds Walker

ONE OF THE LATEST contributions to material handling is the new line of walking draglines announced by The Marion Steam Shovel Co., Marion, Ohio.

When digging the upper frame of the walking type machine rests on a large diameter base or tub, which results in a low bearing pressure.

One of the features of the Marion Walker is that, at the initial stage of the walking step, suction on the tub or base is broken rapidly and the movement of the base is such as to raise it quickly and thus lower the resistance against movement of the material into which the tub may have sunk. The walking movement is actuated by cranks, one on each end of a large diameter shaft, which is mounted across the rotating frame and extends outward on each side. Each crank is connected to a walking "shoe" which, when the crank is rotated, makes contact with the ground to support the weight of the machine, while the dragline moves in the desired direction. This cycle is repeated, the cranks alternately raising the walking shoes, moving them forward until they make contact with the ground and then moving the machine itself.

These new Marion walking draglines are available with bucket sizes from 3 to 12 cu yds in capacity and booms from 80 to 200 ft in length. Power may be either electric or Diesel, at the user's option.

Low-Cost Motor Grader

THE W-SPEED Patrol—a new low-cost motor grader—has been announced by Allis-Chalmers Manufacturing Co., Milwaukee, Wis. This new machine has been designed to handle, at a minimum cost, all road maintenance, average construction work, and light ditching.

The long wheel base (120 in.), wide front axle, and the grader type blade and drawbar enable this unit to build and clean ditches—making it a ditch-to-ditch maintenance machine. This new machine is equipped with a 10 ft reversible moldboard. The lifting mechanism is easily operated by two large handwheels. With speeds up to 10 m.p.h., this one-man unit can maintain 3 to 5 miles of road per hr.

The W-Speed Patrol is powered by a medium speed four cylinder tractor engine developing 31 h.p. at 1300 r.p.m. with a reported fuel consumption of one gal per hr. Having a total weight of 5960 lb this patrol can exert a blade pressure of 4780 lb. Electric starting and lights are standard equipment.

New Telescoping Scraper

MORE "PAY DIRT" per pound draw bar pull is claimed by R. G. LeTourneau, Inc., Peoria, Ill., for their new, double bucket, cable controlled Carryall Scraper, the SU, rated at 14 cu yds truck capacity and 18 heaped.

To permit loading without the aid of a pusher, the scraper blade is narrowed to 8 ft 6 in. and a patented double bucket bowl used. The narrow cutting edge and two telescoping buckets give the effect of loading successively two small scrapers with a large tractor.

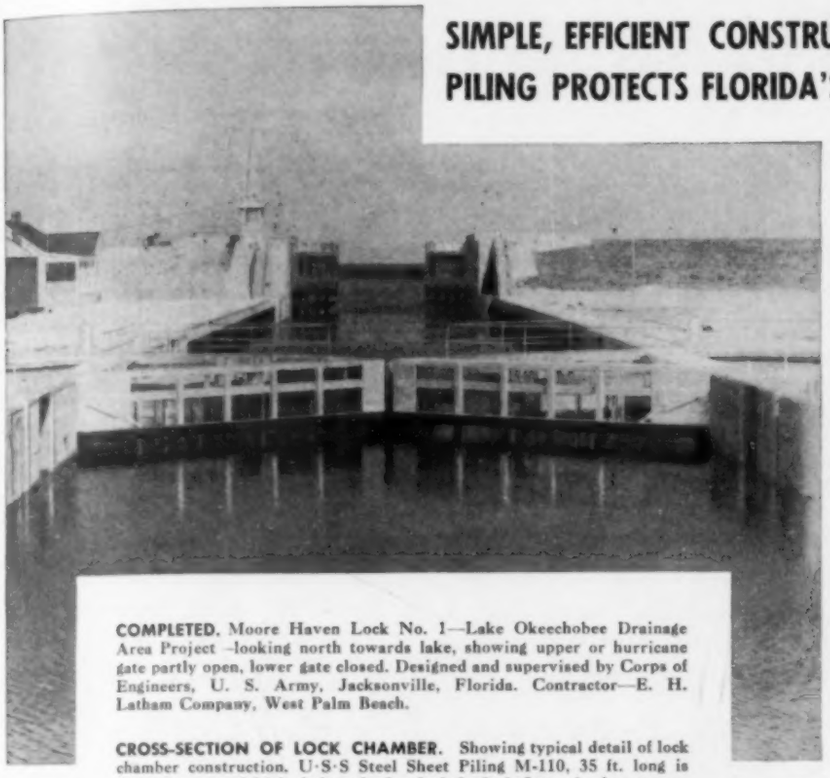
Positive mechanical ejector tailgate is said to completely remove contents from bowl bottom and sides even when operating in wet and sticky material under adverse working conditions. This same positive load ejector controls the measured spreading of material from 1 in. to 16 in. All dirt is pushed out the apron opening in front to eliminate void in fills.

Scraper wheels roll within the scraper blade width and permit cutting and finished work right up to a fence line or grade stake. The SU model does not replace any Carryall in the LeTourneau line.

Sturdy Walls of Steel

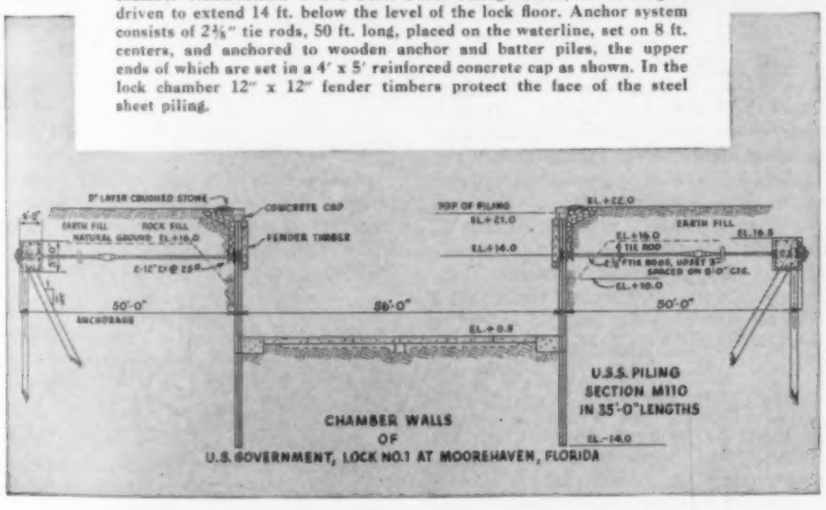
safeguard this Lake Okeechobee Lock

SIMPLE, EFFICIENT CONSTRUCTION WITH U·S·S STEEL SHEET PILING PROTECTS FLORIDA'S CROSS-COUNTRY WATERWAY



COMPLETED. Moore Haven Lock No. 1—Lake Okeechobee Drainage Area Project—looking north towards lake, showing upper or hurricane gate partly open, lower gate closed. Designed and supervised by Corps of Engineers, U. S. Army, Jacksonville, Florida. Contractor—E. H. Latham Company, West Palm Beach.

CROSS-SECTION OF LOCK CHAMBER. Showing typical detail of lock chamber construction. U·S·S Steel Sheet Piling M-110, 35 ft. long is driven to extend 14 ft. below the level of the lock floor. Anchor system consists of 2⅛" tie rods, 50 ft. long, placed on the waterline, set on 8 ft. centers, and anchored to wooden anchor and batter piles, the upper ends of which are set in a 4' x 5' reinforced concrete cap as shown. In the lock chamber 12" x 12" fender timbers protect the face of the steel sheet piling.



THE Moore Haven Lock No. 1 on the Caloosahatchee River, Florida, is an important part of the U. S. Government project for providing a navigation channel at least 6 ft. deep and 80 ft. wide from the Atlantic Ocean to the Gulf of Mexico at Fort Meyers.

In this control structure, a combined hurricane gate and lock, the lock chamber proper is 50 ft. wide and 250 ft. long. To simplify the construction of the lock chamber and cut-off walls, some 800 tons of U·S·S Steel Sheet Piling were used; Section M-110, 35 feet long, in the lock walls and Section M-115, 20 feet long, in cut-off walls.

U·S·S Steel Sheet Piling was used here for the same good reasons that have led to its selection in so many other Florida projects and elsewhere —great strength, long life, low cost of installation, low expense for maintenance. Assembled in small units, it forms a wall that is water-tight and *continuous*—a sturdy barrier, strong to keep water in its place, free from marine borer attack and attractive in appearance as well.

Available in straight-web, arch-web and in the new "Z" sections, U·S·S Steel Sheet Piling is a rugged, lasting product. A *finished* product as shipped — ready to be handled and driven under the most difficult conditions of soil, water and surf. In breakwaters, bulkheads, seawalls, revetments, jetties, and groins, it provides ideal and economical protection against waves and tempest, against drifting and abrading sand. We welcome the opportunity of discussing its possibilities with you.

USS

STEEL SHEET PILING

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

Columbia Steel Company, San Francisco, *Pacific Coast Distributors*

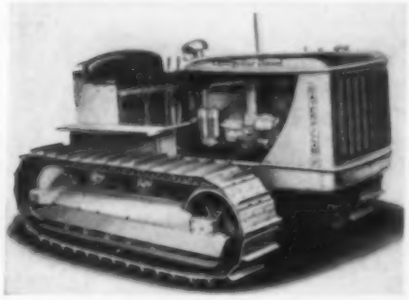
United States Steel Export Company, New York

UNITED STATES STEEL

New 75 H-P "Cat" Diesel

CATERPILLAR TRACTOR CO. has announced a new 75-drawbar h.p. Diesel D7 tractor.

To reduce operator fatigue, the new D7 tractor has "finger tip" steering. A light pull on the steering clutch lever is sufficient to steer the 23,500 lb. machine. A restful and wide driver's seat, located high and well forward on the tractor, gives a clear view of the work ahead and behind. Small seats on both the left- and right-hand arms of the main seat provide a comfortable place from which the driver can operate rear-power-controlled equipment.



In order to obtain the greatest possible strength and at the same time keep weight within the correct limits, welded steel construction is used extensively. The frame and steering clutch case are of this construction, and are built into a one-piece unit. The durability of gears, steering clutches, and flywheel clutch has also been increased. Metallic facings for flywheel and steering clutches assure long-life and freedom from adjustment. The new D7 tractor is powered by a heavy-duty, four-cylinder, valve-in-head, "Caterpillar" Diesel engine. It has a bore and stroke of $5^3/_4$ in. $\times$ 8 in. and a full load governed r.p.m. of 1000. Belt h.p. is 87; drawbar, 75.

A broad range of speeds is provided on the new D7 tractor, with either of two 5-speed transmissions. The low-speed transmission has five forward speeds ranging from 1.4 m.p.h. to 5.00 m.p.h.; while the high-speed transmission has speeds from 1.4 m.p.h. to 6.00 m.p.h.

For each of the first four forward speeds, there is a corresponding but slightly higher reverse. This is obtained by means of a quick reverse shifting lever, which works independently of the change speed shifting lever. It is possible to change from any of the first four speeds to the corresponding reverse speed by merely pushing forward on one lever, the flywheel clutch having been first disengaged. This is particularly advantageous in bull-dozing.

Bucyrus-Erie Excavator

A NEW EXCAVATOR that offers rugged strength combined with speed-lined design and mobility is now being offered by Bucyrus-Erie Co., South Milwaukee, Wis. It is the $2^1/_2$ yd 54-B, a Diesel-powered convertible shovel, dragline, clamshell, lifting crane, completely described in Bulletin No. 54-B1.

With husky quarry-type boom, wide outside dipper sticks, modern welded heavy-duty dipper, and positive independent crowd, the 54-B shovel front-end is the same type used so successfully on the 4, 5, and 6 yd Bucyrus-Erie quarry and mining shovels. Yet the machine is so compact that it comes within clearances of most U.S. standard gauge railroads and can be shipped without major dismantling. Clearances are reduced, and the center of gravity lowered, by combining roller path and swing rack in the truck frame casting. Center pintle and the heavy reinforcements necessary to support it are eliminated by the use of single plane conical hook rollers. A-frame is arranged so that it can be easily lowered without dismantling the cab; and all excess weight is eliminated by the use of special modern, high-strength, light-weight alloy steels. Consequently, the 54-B offers a compactness and mobility which, the manufacturer claims, has never before been found in a machine of such large capacity.

Luminaire for Tunnels

A SODIUM LUMINAIRE with a boxed casing for permanent casting into tunnel ceilings or walls has been announced by the General Electric Co., Schenectady, N.Y. It is designed expressly for vehicular tunnels and, when installed, is flush with the tunnel ceiling or wall surface.

Alzak finished aluminum reflecting surfaces in the luminaire assure high utilization of the sodium light output. Protecting these surfaces from dust and dirt is an enclosing glass door. The new luminaire employs a 10,000-lumen sodium lamp and may be directly connected to a low-voltage series circuit through a recommended IL insulating transformer. The luminaire is equipped with a standard cathode, preheating, automatic resetting timer and a radio interference suppressor.

Engine-Driven Welder

A NEW 200 ampere engine-driven arc welder, which is reported to be exceptional in light weight, small size, and low cost for an engine-driven unit of its capacity, is announced by The Lincoln Electric Co., Cleveland, Ohio.

The new welder, designated the "SAE-200 J," is of the Junior type, and weighs under 900 lb., light enough to be wheeled by one man.

The "Lincoln Junior," with a current range, welding duty, from 40 to 250 amperes for bare, washed, or heavily coated electrodes, is available as a portable unit with steel-wheeled running gear, shop type, and as a stationary unit.

New Drifter Drill

A NEW Drifter Rock Drill, the 100B, has recently been announced by the Independent Pneumatic Tool Co., 600 W. Jackson Blvd., Chicago, Ill. The 100B is designed for heavy-duty drifting in mining and large tunnel work.

Used with $1^1/_4$ in. and $1^1/_2$ in. round lugged steels, its power and strong rotation are reported to give it remarkable drilling speed in the hardest formations. A constant blowing action keeps the hole clean and for final hole cleaning a manually operated valve is easily accessible for extra blowing power.

Catalog No. 42 gives complete details and specifications on this drill and on other tools in the Thor line.

Literature Available

AERATION—"Aerators," Bulletin No. 100, issued by International Filter Co., 325 W. 25th Place, Chicago, Ill., discusses the purifying functions of aeration and describes and illustrates the various types of aerating equipment available.

AERIAL MAPPING—The maps produced and the methods employed in their production by Continental Aerial Surveys, Paul Brown Bldg., St. Louis, Mo., are described in a 16-page booklet.

DIESEL ENGINES—"Alco Diesel for Universal Application" is the title of a 16-page catalog issued by American Locomotive Co., 30 Church St., New York, N.Y.

DIESEL ENGINES—A concise yet comprehensive explanation of modern high-speed, heavy-duty Diesel engines is covered in a new booklet just issued by Hercules Motors Corp. of Canton, Ohio.

GATE VALVES—A bulletin describing water gate valves built in conformance with the new specifications of the A.W.-W.A., published by The Kennedy Valve Manufacturing Co., Elmira, N.Y.

PORTABLE COMPRESSORS—Schramm, Inc., of West Chester, Penna., are distributing a new 22-page catalog, Bulletin 3900 CG, of their complete line of "Utility" Portable Air Compressors. Sizes from 85 to 420 cu ft capacity are listed, available with gasoline or Diesel engine power.

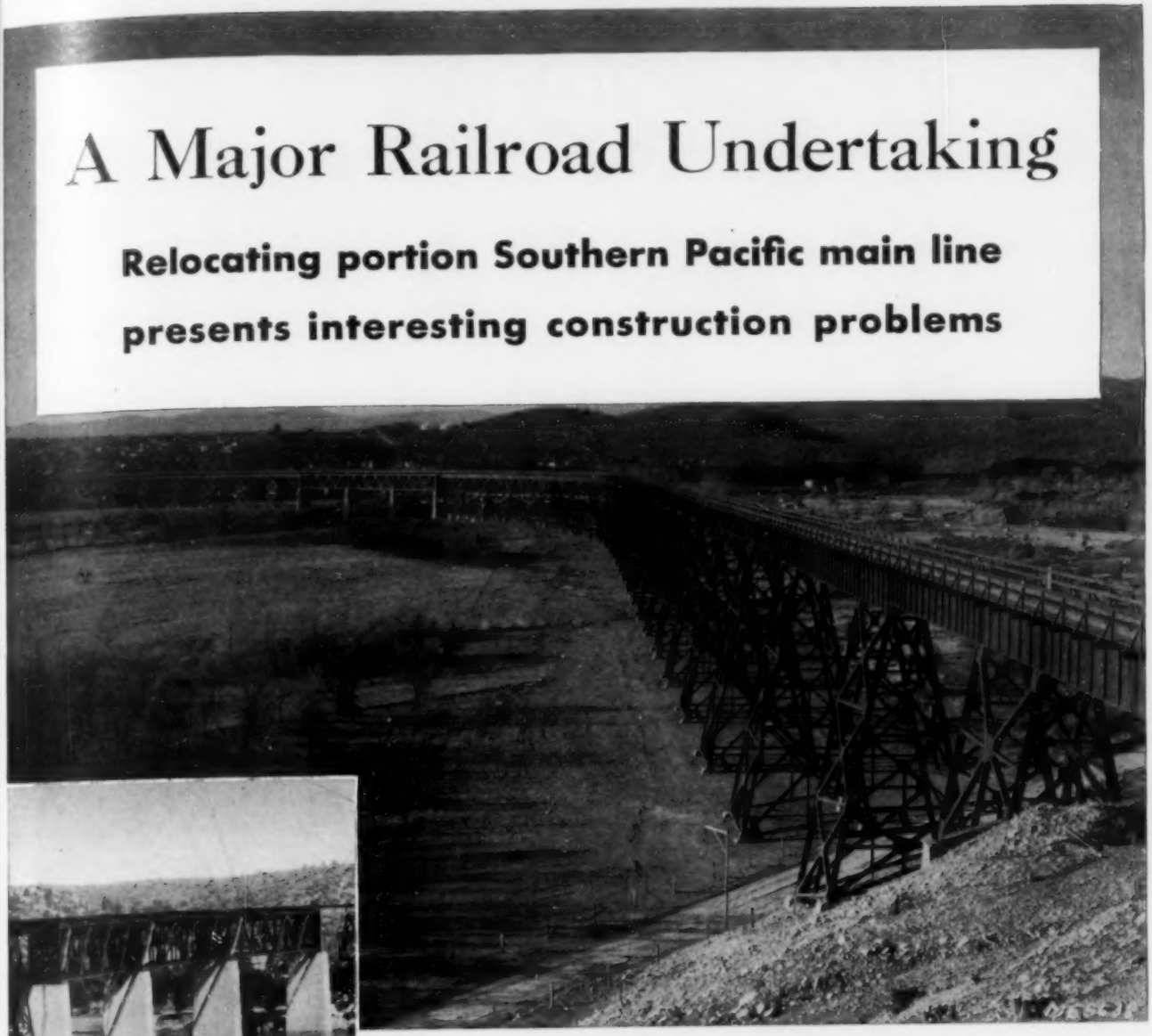
TRANSIT-LEVEL—A six-page folder describes the construction and the advantages of the W-K transit-level. Warren Knight Co., 136 North 12th St., Philadelphia, Penna.

WINTER CONCRETE—"Portland Cement Below 50° F," an interesting little folder, outlines quickly and concisely the values claimed for the use of calcium chloride in concrete mixes. Solvay Sales Corp., 40 Rector St., New York, N.Y.

WRINKLE BENDING PIPE—The recently perfected wrinkle-bending method for bending pipe, which employs the oxy-acetylene flame for heating a narrow band about halfway around the pipe at the point to be bent, is fully described in a booklet entitled "Wrinkle Bending," available from The Linde Air Products Co., 30 East 42d St., New York, N.Y.

A Major Railroad Undertaking

Relocating portion Southern Pacific main line presents interesting construction problems



The First Crossing of the Sacramento River near Redding, Calif., Southern Pacific Railroad relocation project, comprises 34 steel tower bents supporting 37 intermediate deck plate girder spans and a 3-span deck truss river crossing. Viaduct girders range from 35 to 80 feet in length, each of the river truss spans is 165 feet 4 inches long. Built for the U. S. Bureau of Reclamation, Central Valley Project.

THIS relocation project, just north of Redding, California, traverses 30 miles of rugged terrain to the east of the river canyon. It takes the place of 37 miles of winding track along the Sacramento River, portions of which, eventually, will be submerged by the stored waters of Shasta Dam. Its hazards find emphasis in the requirements for 12 tunnels and 8 major bridges. Of the eight bridge structures, American Bridge, to date, has under construction or completed, five—the Pit River, the Salt Creek and the First, Third and Fourth Crossings of the Sacramento.

The largest of the now completed bridges is the First Crossing of the Sacramento River, near Redding. This single track deck viaduct on curve and grade, sweeping across the river bottoms from the heights on either side, is 4271 feet long and required some 5870 tons of fabricated steel. Complete erection of the steel superstructure—including the installation of the timber deck, walkways, handrails and track—was undertaken under a rigid contractual schedule, which American Bridge Company, actually, anticipated by three weeks.

AMERICAN BRIDGE COMPANY

General Offices: Frick Building, Pittsburgh, Pa.

Baltimore · Boston · Chicago · Cincinnati · Cleveland · Denver · Detroit · Duluth
Minneapolis · New York · Philadelphia · St. Louis

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

Men Available

Items are furnished by Engineering Societies Employment Service, 31 West 39th Street, New York, N.Y. Address replies to key number, care of New York Office, unless Chicago or San Francisco office is designated. See page 125 of Society's 1939 Year Book for details of procedure.

CONSTRUCTION

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 41; M. C. E.; licensed professional engineer and land surveyor, New York State; speaks Spanish; 16 years experience—land surveys, topography; location, construction, and maintenance of railroads and hihgways; desigu and construction of hydraulic structures and buildings. Location immaterial. C-647.

CONSTRUCTION ENGINEER; M. Am. Soc. C.E.; seeks industrial or commercial engagement as manager of construction from design to occupancy with owner-builder interested in time and cost saving on new plant erection or expansion; 30 years experience, including 23 years management of general building contracting business with record of economical and satisfactory completions and intensive application. C-659.

DESIGN

ENGINEER; Assoc. M. Am. Soc. C.E.; 34; married; 12 years experience—United States and foreign countries, in engineering design and construction of smelters and mills. Texas license. Desires permanent connection. C-645-397-E-4-San Francisco.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; graduate; 30; registered in Pennsylvania; 4 years experience in structural steel design and detail; 5 years surveying; 2 years supervising construction of airports and stadiums and handling of labor. Wishes to locate in northeastern Pennsylvania with a consulting engineer. C-648.

EXECUTIVE

CIVIL ENGINEER; M. Am. Soc. C.E.; 41; desires sales or executive connection in North or South America, or China. Speaks Spanish and Chinese; reads French. Public speaker; writer. Adaptable, energetic, cooperative. Presentable, good personality. Mason, Rotarian, American Legionnaire. Broad experience, United States, Mexico, China; construction, asphalt, highways, general municipal administration. Good connection more important than salary. C-646.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 25 years experience, flood control, drainage, railroads, highways. Surveys, construction, design. Contractor's engineer, estimating and supervising construction on dredging, earth moving, bridges, foundations, docks, concrete structures, sewers, and water works. Experienced with floating equipment. Can direct working men and make contacts with business people. C-649.

CONSTRUCTION EXECUTIVE; M. Am. Soc. C.E.; graduate engineer. Over 30 years varied experience in a broad field of engineering and building construction, domestic and foreign, including experience as estimator, job superintendent, chief engineer, general superintendent, and local manager for contractors. Now open for engagement. Excellent health; will consider any location. C-656.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; B.S., Columbia University; C.E., Columbia University; Theta Tau; high scholastic record; 1½ years experience in field on large foundation jobs; 9 months experience as job engineer and job office manager. Desires job with opportunity for advancement to position of responsibility. Will go anywhere. Available immediately. C-650.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; married; graduate of Cornell University, C.E., 1938; 2 months as transitman on highway relocation; 13 months with heavy engineering construction firm. Plant structures and form design; quantity estimates; and field engineer on bridge pier job. Available immediately; location immaterial. C-651.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; single; B.S.C.E., University of Vermont, 1939; 3 months as transitman on boundary locations; 7 months as transitman on highway relocation surveys. C-652.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; married; B.S.C.E., North Carolina State College; honor graduate; survey, design, supervision of small water and sewer systems; roads, drainage structures, 40,000-cu yd earthfill dam, stone masonry dam; estimating experience; direct supervision over three surveying parties. Now employed. C-654.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; B.S.C.E., University of Wisconsin, June 1939; 2 months assisting engineers on highway surveys; 5 months inspecting concrete sewer construction in tunnel and open-cut including manhole and chamber construction; a position with a hydraulic, structural, or consulting engineering firm is desired. Available immediately; location immaterial. C-655-64 Chicago.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; married; B.C.E., Ohio State University; licensed surveyor; 1 year in city engineer's office; 1 year and 8 months with consulting sanitary engineer, as draftsman, field engineer, inspector, and contact man. Employed at present. Desires stable opening; location immaterial; references. C-658.

TEACHING

CIVIL OR HYDRAULIC ENGINEERING; Jun. Am. Soc. C.E.; B.S.C.E.; M.S.; candidate for C.E.; 7 years successful teaching experience at one school. Instructor and assistant professor. Professional contact through summer work with government agencies; 1½ years with public utility. Prefers change for teaching position; would consider professional opening. C-653.

CIVIL AND STRUCTURAL ENGINEER; Assoc. M. Am. Soc. C.E.; 40; B.S., M.S., and C.E.; 3 years surveying topography, construction, water supply, triangulation; 12 years designing, shopdrawing, estimating bridges, viaduct, industrial and office buildings. Expert on indeterminate structures and 2 years teaching of the subject. East or South. C-657.

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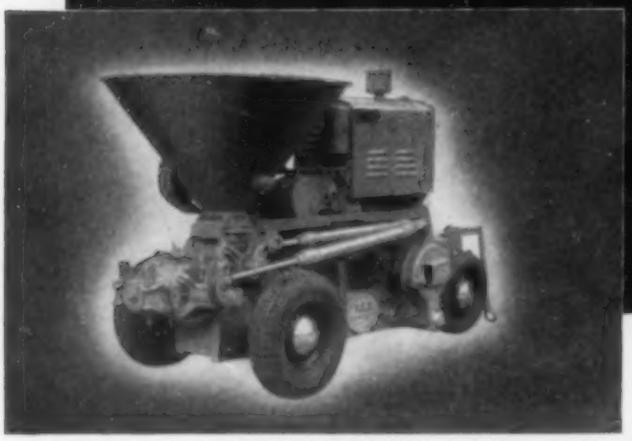

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BRIDGES

CONCRETE ARCH, SWITZERLAND. Scheitelhebung der Aarebruecke SBB Bern und Regulierpressung der Eisenbeton-Gewoelbes, A. Staub. *Schweizerische Bauzeitung*, vol. 113, no. 8, Feb. 25, 1939, pp. 93–95. Observations on movement of crown of concrete arch railroad bridge, 150 m in span, over Aare River near Bern, Switzerland, following completion of concrete work; use of hydraulic jacks for producing compressive stresses in arch to regulate arch deformation.

CONCRETE, PONTOON. Rigid Concrete Pontoon Bridge, E. E. R. Tratman. *Engineer*, vol. 168, nos. 4361 and 4362, Aug. 11, 1939, pp. 154–156, and Aug. 18, pp. 178–179. Bridge of unusual type crosses arm of Lake Washington to carry highway from Seattle; feature of interest is telescoping draw or movable span; bridge consists of series of 22 rectangular pontoons; instead of floating independently, most of pontoons are connected by heavy bolts and shear locks to form rigid box-like structure.

CONSTRUCTION, EMERGENCY. Training in Emergency Bridge Erection. *Engineering*, vol. 148, no. 3847, Oct. 6, 1939, pp. 380–381. Steps taken by British Ministry of Transport to provide means for rapid reconstruction, either of whole bridge or part of one, in event of damage; country has been divided into eight sections and, at convenient place in each, depot of material has been formed; material for most part consists of standardized parts of Callender-Hamilton Unit-Construction bridge of modified Warren girder type; steps taken to ensure effective handling of stored material in case of emergency.

MASONRY. Il Ponte Murario Romano, G. Albenga. *Ingegnere*, vol. 17, no. 10, Oct. 15, 1939, pp. 869–873. Historical note on structural features of old Roman masonry bridges. Bibliography.

NEW YORK CITY. Vehicular Connection Between Battery, Borough of Manhattan, and Hamilton Avenue, Borough of Brooklyn, and Approaches Thereto, R. G. Tugwell, L. M. Orton, J. C. Riedel, and C. Rodgers. *Mun. Engrs. J.*, vol. 25, 2d Quarterly issue 1939, pp. 51–66. Report of New York City Planning Commission approving construction of vehicular bridge between Battery, Manhattan, and Borough of Brooklyn; bridge versus tunnel connection between two boroughs; estimated cost.

PIERS. Canopy Type Towers, W. G. Grove. *Roads & Streets*, vol. 82, no. 11, Nov. 1939, pp. 49–52. Design and construction of canopy bridge towers for new bridge over Housatonic River, between Stratford and Derby, Conn., consisting of series of through plate girder spans ranging in length from 128 to 224 ft.

RAILROAD. Federal Funds Build Attractive Grade Separation Structures. *Ry. Age*, vol. 107, no. 23, Dec. 2, 1939, pp. 852–854. Commentary on three overhead railroad bridges completed recently on Chesapeake & Ohio at Columbus, Ohio; special treatment of masonry; 2-, 3-, and 4-track structures; reinforced box-type abutments; excavation done under traffic.

SUSPENSION, CABLE SADDLES. Welded Cable Saddles for Tacoma Narrows Bridge, J. Jones. *Welding J.* (N.Y.), vol. 18, no. 11, Nov. 1939, pp. 694–696; see also *Western Construction News*, vol. 14, no. 11, Nov. 1939, pp. 377–378. Pioneer use of welded structural plates for saddles of 17-in. cables of Tacoma Narrows suspension bridge in place of usual cast construction, thus eliminating cost of patterns; cable load transfer; fabricating processes; welding. Before Am. Welding Soc.

BUILDINGS

AIR CONDITIONING, EXHIBITION BUILDINGS. Uniform Temperature and Humidity Protect Valuable Italian Exhibit. *Heating, Piping & Air Conditioning*, vol. 12, no. 1, Jan. 1940, pp. 5 and 9. Precautions to guard Italian masterpieces of art against deterioration taken by Art Institute of Chicago; described; radiator vent valve humidifiers installed; air is exhausted from galleries to attic space by centrifugal fan.

AIR CONDITIONING, OFFICE BUILDINGS. Du Pont Spends Million for Air Conditioning. *Heating, Piping & Air Conditioning*, vol. 12, no. 1, Jan. 1940, p. 10; see also *Refrig. Eng.*, vol. 39, no. 1, Jan. 1940, pp. 46–47. Recently completed installation of air conditioning system in company's headquarters building, Wilmington, Del., is briefly described and illustrated; capacity of system is 358,740 cfm of air circulated through 5.3 miles of ducts from 42 conditioning units to which chilled water from refrigerating plant is piped.

HOUSING, NEW YORK CITY. Metropolitan's Parkchester. *Arch. Forum*, vol. 71, no. 6, Dec. 1939, pp. 412–426. Description of Parkchester development of Metropolitan Life Insurance Company in the Bronx (New York City), comprising 51 multi-story buildings situated on tract of 129 acres, designed to house 42,000 people; design and construction of buildings; features of central heating plant; estimated cost of development about $50,000,000.

SKATING RINKS. Concrete Barrel Shell and Arched Ribs Are Features of Skating Rink. *Concrete*, vol. 47, no. 9, Sept. 1939, pp. 3-4. Construction type found economical in building of new rink at Ardmore, Pa.; four sections permit re-uses of falsework and forms.

SOUNDPROOFING. Technique of Sound Insulation. *Surveyor*, vol. 96, nos. 2487 and 2491, Sept. 22, 1939, pp. 281–283, and Oct. 20, pp. 355–356. Principles of soundproofing in rigidly continuous structures; transmission of sound; diagrammatic indication of how air-borne sound travels in continuous building structure; diagram to determine approximate adequacy of building structures to insulate indoor air-borne noises; experimental work; examples.

CITY AND REGIONAL PLANNING

GREAT BRITAIN. City-Planning, with Special Reference to Operation of Restriction of Ribbon Development Act, 1935, H. J. B. Manzoni. *Instn. Civ. Engrs.—J.*, no. 1, Nov. 1939, pp. 7–20. Review of city planning developments in Great Britain during past 30 years; development prior to introduction of planning powers; planning of built-up areas; growth of urban areas; preservation of rural areas; control of urban expansion; road system of British Isles; restriction of Ribbon Development Act, 1935; modern road design.

GREENBELT, MD. Planned Community Appraised. *Arch. Forum*, vol. 72, no. 1, Jan. 1940, pp. 62–63 and 34. Description of report on operation of U.S. government housing development of Greenbelt, Md., having population of 3,100.

MUNICIPAL TRANSPORTATION. Staedtebau und Nahverkehr, R. Niemeyer and V. Henning. *Verkehrstechnik*, vol. 20, nos. 18 and 19, Sept. 20, 1939, pp. 434–439, and Oct. 5, pp. 453–455. City planning and suburban transportation; valuation of means of transportation; influence of suburban requirements on types of transportation, development of systems; influence of motorized transportation.

CONCRETE

HYDRAULIC STRUCTURES. Concrete for Hydraulic Structures, G. S. Latin. *Engineer*, vol. 168, nos. 4376 and 4377, Nov. 24, 1939, pp. 527–528, and Dec. 1, pp. 550–551. Method at present employed by Swedish Royal Board of Waterfalls for testing impermeability of concrete consists in forcing water at high pressure through massive cylinders from one end to other; ordinary cylindrical test specimens, 300 mm long, and 150 mm in diameter, are used.

WATER PIPE LINES. Metropolitan Boston's New Water Supply System, W. R. Brend. *Can. Engr.*, vol. 77, no. 22, Nov. 28, 1939, p. 9. Outline of design features and fabrication methods of variable size 10-mile steel concrete pipe line now

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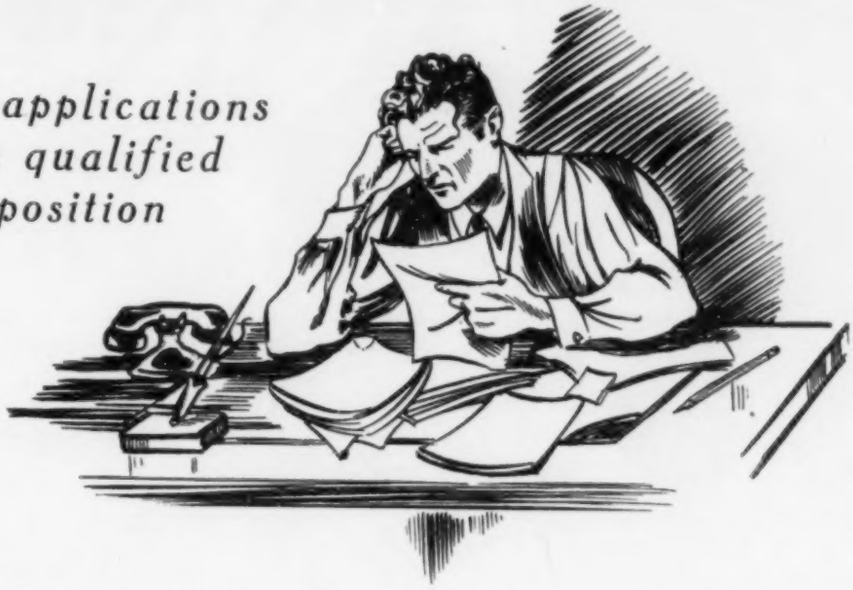

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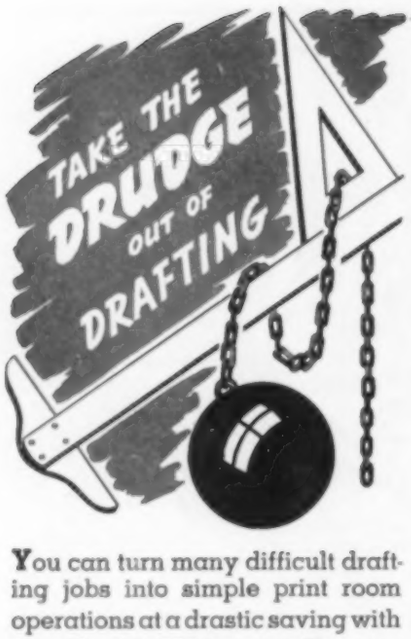

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CONSTRUCTION INDUSTRY

ADVANCES. Advances in Construction Methods and Equipment, W. S. Wilson. *Civ. Eng.* (London), vol. 34, no. 400, Oct. 1939, pp. 355–359. Extracts from paper before Brit. Am. Eng. Congress discussing more unusual and less standardized methods of construction and equipment as employed on number of contracts recently carried out; Chelsea Bridge pier cofferdam; reinforced concrete chimney; rolling out of spans of Baghdad bridge.

DAMS

CONCRETE GRAVITY, FRANCE. Genissiat Dam. *Engineer*, vol. 168, no. 4376, Nov. 24, 1939, pp. 510–512 and 520. Supplementing article previously indexed from Dec. 30, 1938, issue of same journal, account is given of present condition and of modifications in design for permanent works approved since beginning of year; design of dam and power station and methods of construction are generally very similar to those employed in Boulder Dam, but on much smaller scale.

EARTH, GREAT BRITAIN. Ladybower Reservoir. *Engineer*, vol. 168, no. 4373 (4380), Nov. 3, 1939, pp. 440–442 and 448. Illustrated description of dam in Derbyshire which will impound between 5,000 and 6,000 million gal of water; dam consists of earthwork embankment 1,250 ft in length, with maximum height of 140 ft; discharge tunnels are formed of concrete and are 12 ft wide and 12 ft high; two overflows consist of bell mouths, 80 ft diameter at top, gradually diminishing to 15 ft.

FISH LADDERS. Bonneville Fishways Improve on Nature, R. G. Skerrett. *Compressed Air Mag.*, vol. 44, no. 8, Aug. 1939, pp. 5950–5954. Design and operation of fish ladders of Bonneville Dam; fish counting stations; handling of fish run.

HYDRAULIC GATES. Lead Seal for Tainter Gates, O. N. Floyd. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, p. 81. Description of lead seal for 12 Tainter gates on Red Bluff Dam spillway, near Pecos, Tex., each 15 ft high by 25 ft wide.

SPILLWAYS, MODEL TESTING. Model Study of Spillway for New Lock and Dam No. 1, St. Lucie Canal, Florida. *U.S. Waterways Experiment Station—Tech. Memo. No. 153-1*, June 20, 1939, 50 pp., supp. plates. Methods and equipment used in testing of 1:25 models of canal spillways with capacity of over 20,000 cu ft per sec for determination of relative effectiveness of three proposed designs; calibration of Tainter gates; determination of safe discharge quantities corresponding to various tailwater stages.

FOUNDATIONS

DAMS. Du role des études géologiques dans les travaux publics, L. Bertrand. *Annales de l'Institut Technique du Batiment et des Travaux Publics*, vol. 4, no. 4, July–Aug. 1939, pp. 13–22. Modern methods of geological exploration of dam sites and other foundations.

DESIGN. Design of Foundations for Stacks and Towers, V. D. Marshall. *Refiner*, vol. 18, no. 12, Dec. 1939, pp. 84–91. Both self-supporting and guyed structures are considered; discussion is based on design of tower foundations, but is also applicable to stacks.

DESIGN. Principles of Foundation Design, H. Chatley. *Engineering*, vol. 148, no. 3857, Dec. 15, 1939, p. 670. Brief summary of procedure and ideas involved in new methods.

PILE DRIVING. Pile Driving Formulae, C. J. Peirce, Jr. *La. Eng. Soc.—Proc.*, vol. 25, no. 4, Aug. 1939, pp. 145–159, supp. plates. Critical review of older and newer pile-driving formulas with special reference to Hiley formula. Bibliography.

SUBSIDENCE. Effect of Excavation on Settlement of Buildings, K. Terzaghi. *Civ. Eng.* (London), vol. 34, no. 400, Oct. 1939, pp. 370–371. Discussion of experimental studies of causes of settlement associated with excavation in vicinity of existing buildings; shafts in soft clay; loss of ground due to shaft sinking; loss due to bulging; methods for reducing loss of ground. Before Brit. Am. Eng. Congress.

HYDRAULIC ENGINEERING

HYDRAULIC MODELS. Model Study of Outer Bar. *U.S. Waterways Experiment Station—Hydraulics Bul.*, vol. 2, no. 3, July 1, 1939, pp. 1–5. Abstract of final report on model study of conditions at outer bar, Lake of Maracaibo, Venezuela; analysis of outer bar-beach-sand movement; effects of providing, by artificial means, channel directly across outer bar.

HYDRODYNAMICS. Path and Stability of Local Vortex Moving Round Corner, A. Miyadzu. *Tôhoku Imperial Univ.—Tech. Reports*, vol. 13, no. 1, 1939, pp. 14–75. Theoretical mathematical discussion of characteristics of motion of irrotational vortex; effects of corner angle and mode of main flow; path and stability of vortex maintained in flow round corner; path and stability of vortex influenced by change of main flow; path and stability of vortex in main flow of finite width; consideration of vortex in cases of complicated boundary. Bibliography. (In English.)

HYDROELECTRIC POWER PLANTS

AUSTRIA. Das Donaukraftwerk Ybbs-Persenbeug, O. Hoehn. *Schweizerische Bauzeitung*, vol. 114, no. 11, Sept. 9, 1939, pp. 138–140. Outline of project for construction of 144,000-hp low-head hydroelectric power plant on upper Danube River at Persenbeug, Austria, including roller dam 192 miles long.

SWITZERLAND. La construction de l'usine de Verbois-Genève, F. Bolens. *Bul. Technique de la Suisse, Romande*, vol. 65, no. 13, July 1, 1939, pp. 169–180. Preliminary studies and plan for construction of Verbois hydroelectric power plant, on Rhone River, for city of Geneva, Switzerland, utilizing flow of 127.5 cu m per sec, including movable dam over 8 m in height; results of model tests of proposed hydraulic structures.

HYDROLOGY AND METEOROLOGY

RAIN AND RAINFALL. Variation in Rainfall Over Short Distances at Cloquet Forest Experiment Station, T. Schantz-Hansen and R. M. Brown. *J. Forestry*, vol. 37, no. 10, Oct. 1939, pp. 804–806. Statistical analysis of rainfall catches in forest and in open areas in northern Minnesota, indicating that variations in rainfall as large as 30 or 40%, but still having no statistical significance, occur within short distances; consequently, older data on influence of forests on rainfall should be used only with greatest circumspection.

WATER LEVEL FLUCTUATIONS. Cycles of Victoria Nyanza and Some Attendant Phenomena, S. M. Wood. *Eng. Soc. Wisconsin—Report*, vol. 14, no. 3, July 1939, pp. 100–119, supp. plates. Study of relationship between solar cycle and water surface elevations of Lake Victoria, Nyanza, Africa, and Great Lakes of North America.

WEATHER FORECASTING. Influence of Topography on Weather Forecasting at Salt Lake City, Utah, G. F. Taylor. *J. Aeronautical Sciences*, vol. 7, no. 1, Nov. 1939, pp. 18–21. Paper is intended to explain only few of more interesting and characteristic synoptic situations of Salt Lake area in which topography plays important rôle; no claim is made to completeness, since innumerable variations of each situation could be given without adding to essential ideas. Before Inst. Aeronautical Sciences.

WEATHER FORECASTING. Weather-Announcing Tape Machine, R. A. Cushman. *Bell Laboratories Rec.*, vol. 18, no. 3, Nov. 1939, pp. 70–72. Weather-announcing machine is now installed at West 50th Street central office building of New York Telephone Company; with this machine, telephone subscribers throughout greater New York may receive authoritative forecasts of weather conditions.

INDUSTRIAL BUILDING

WALLS. Wall Details for Concrete Industrial Buildings. *Eng. & Contract. Rec.*, vol. 52, no. 36, Sept. 6, 1939, pp. 9–11. Factors to be considered in design of factory walls, including window arrangement, reinforcing methods, and provision for expansion and insulation.

INLAND WATERWAYS

CANALS, BELGIUM. Albert Canal, Belgium. *Engineering*, vol. 148, nos. 3847, 3849, 3851, 3854, and 3857, Oct. 6, 1939, pp. 375–377; Oct. 20, pp. 431–433; Nov. 3, pp. 489–491 and 502; Nov. 24, pp. 574–576; and Dec. 15, pp. 657–660 and 656. Supp. plates. Detailed illustrated description including maps, preceded by review of transport conditions in Belgium.

IRRIGATION

STORM DRAINAGE. Storm-Drainage Structures on All-American Canal, G. W. Manly. *Reclamation Era*, vol. 29, no. 11, Nov. 1939, pp. 302–305. Construction of siphons, overshoots, and drainage inlets to dispose of flood discharge of numerous normally dry creeks, running perpendicularly to direction of All-American Canal.

LAND RECLAMATION AND DRAINAGE

AGRICULTURAL ENGINEERING, SWITZERLAND. Fuenfzig Jahre Kulturingenieur-Ausbiedung an der Eidgen. Technischen Hochschule. *Schweizerische Bauzeitung*, vol. 113, no. 24, June 17, 1939, pp. 285–308. Symposium on 50 years' agricultural engineering instruction at Federal Institute of Technology, Zurich, Switzerland, including articles in French, German, and Italian on development of instruction in agricultural engineering and description of agricultural developments; reclamation and irrigation projects in Switzerland.

CULVERTS, CONSTRUCTION. Culverts. *Roads & Road Construction*, vol. 17, nos. 202 and 203, Oct. 2, 1939, pp. 310–312, and Nov., pp. 340–342. Description of several economic methods for construction of masonry culverts, including reinforced concrete culverts; pipe culverts.

MATERIALS TESTING

CONCRETE. Ueber die Pruefung von Betonwuerfeln von 10 cm Kantenlaenge aus erdfeuch-

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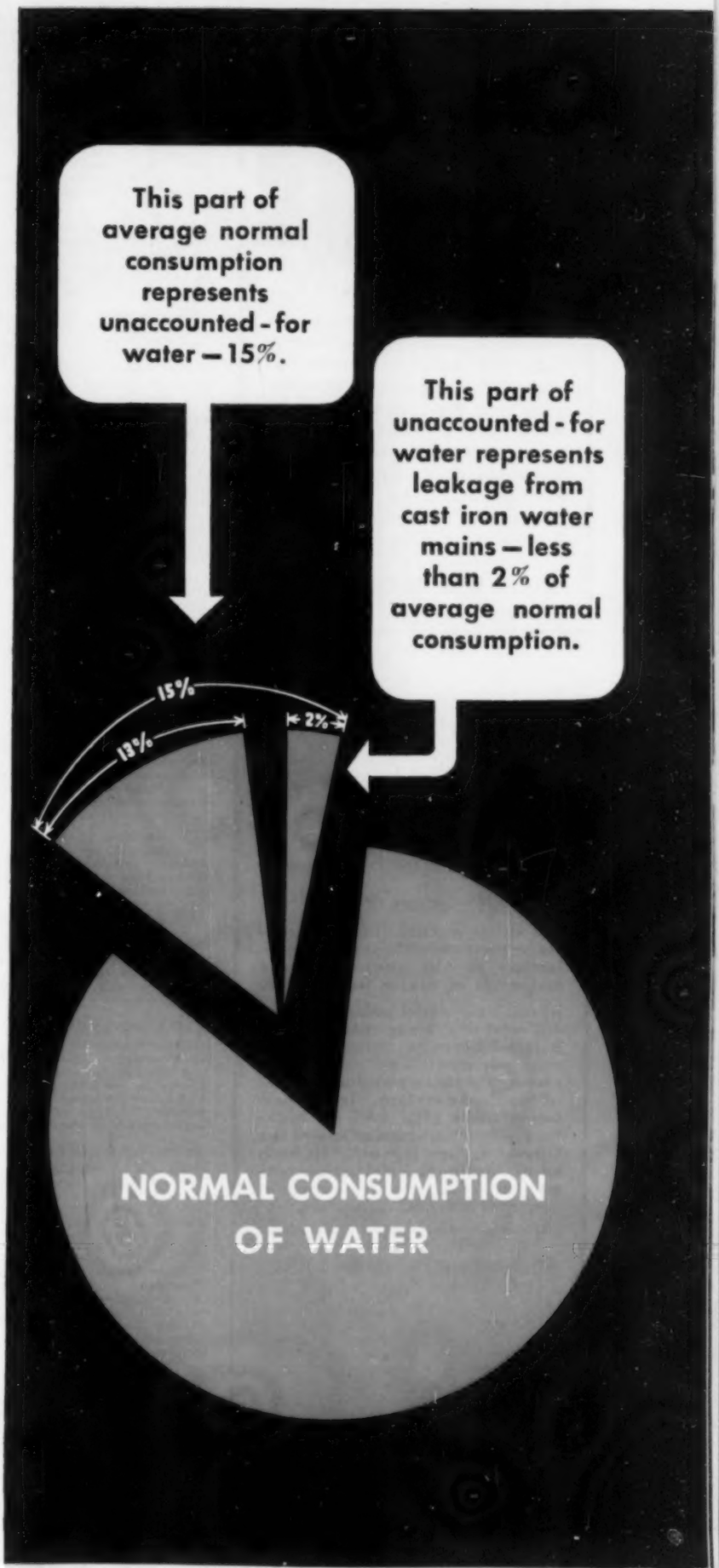
This part of average normal consumption represents unaccounted-for water—15%.
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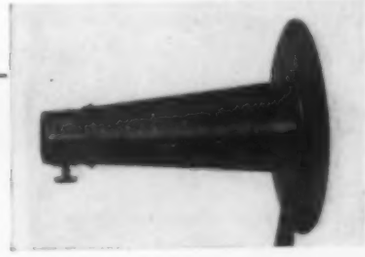

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tem Beton, K. Seidel. *Zement*, vol. 28, no. 38, Sept. 21, 1939, pp. 586–588. Testing of concrete cubes of 10-cm side length composed of slightly moist concrete; results of author's tests, based on which it is recommended that test cubes of this size be permitted in German specifications for slightly damp concrete.

STEEL FATIGUE. Fatigue Problems in Structural Designs, A. V. Karpov. *Metals & Alloys*, vol. 10, nos. 11 and 12, Nov. 1939, pp. 346–352, and Dec. pp. 381–388. Fatigue properties of structural alloys; fatigue diagrams; fatigue properties of structural elements; riveted and welded joints; welded and riveted plate girders.

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GRANDSTANDS. Grandstands for Municipal Sports Grounds, W. G. Douch. *Surveyor*, vol. 96, no. 2486, Sept. 15, 1939, pp. 265–268. Legal and financial provisions; selection of materials; timber construction; practical requirements; design of structure; roof and gallery construction.

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HYDRAULIC MODELS. Investigation of Outer Approach-Channels to Port of Rangoon by Means of Tidal Model, O. Elsden. *Dock & Harbour Authority*, vol. 19, nos. 227 and 228, Sept. 1939, pp. 323–327, and Oct., pp. 351–355 Results of tidal model studies of conditions in Irrawaddy delta and Rangoon estuary; design, construction, and adjustment of model; trial runs of model; predictive runs; study of remedial works.

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SHORE PROTECTION, GREAT BRITAIN. Coast and River Conservancy, E. Latham. *Engineering*, vol. 148, no. 3854, Nov. 24, 1939, pp. 571–573, supp. plate. Consideration of what is happening round English coast at present; those parts of coast which require artificial aid are reduced to crumbling cliff sections and low-lying coastal lands or marshes below high water levels.

SOUTH AFRICA. Harbours of South Africa. *Engineer*, vol. 168, no. 4372, Oct. 27, 1939, pp. 416–419. Illustrated description of Cape Town docks, Port Elizabeth, Port of East London, and Durban Harbor.

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SPAIN. Le programme des grands travaux publics en Espagne. *Génie Civil*, vol. 115, no. 2988, Nov. 18, 1939, pp. 365–368. Review of program for reconstruction of public works in Spain, including highway, irrigation, and port construction.

RAILROADS, STATIONS, AND TERMINALS

STRUCTURES—HARBORS AND RIVERS. Report of Committee 25—Waterways and Harbors. *Am. Ry. Eng. Assn.—Proc.*, vol. 41, no. 413, Nov. 1939, pp. 172–181. Breakwaters, bulkheads, and jetties; transfer bridges and other facilities; selection of type of construction of piers in various kinds of water.

ROADS AND STREETS

DESIGN. Design of Roads, R. G. H. Clements, *Roads & Road Construction*, vol. 17, no. 202, Oct. 2, 1939, pp. 306–309. Design of state highway system; design of structures; traffic surveys; separation of traffic streams; junctions; traffic signals. Before Brit. Assn. for Advancement of Science.

EAST AFRICA. L'Autostrada Assab-Sardo, E. Mastrigli. *Strade*, vol. 21, no. 7, July 1939, pp. 341–352. Construction of new automobile highway, 248 km long, between Assab and Sardo in Italian East Africa, featuring use of native abor and simple construction equipment.

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ROMAN ROADS. Le Grandi Strade del Mondo Romano, B. Bolis. *Strade*, vol. 21, no. 4, Apr. 1939, pp. 157–167. Historical notes on classification, design, and construction of highways in old Roman Empire, including roads in swampy and rocky regions.

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SNOW REMOVAL. New Snow-Removal Equipment. *Can. Engr.*, vol. 77, no. 16, Oct. 17, 1939, pp. 19, 20, 22, 24, 26, 28, 30, and 32. Features of standard commercial snow-removal equipment, including rotaries and blowers, trucks, graders, tractors, maintainers, plows, and loaders.

SNOW REMOVAL. Trend in Snow-Plowing, T. Johnston. *Can. Engr.*, vol. 77, no. 16, Oct. 17, 1939, pp. 8–11. Review of 20-year progress in equipment and methods for snow removal from streets and highways; tractor plows; development of V-plow; rotary plows; repair service; Canadian snow-fall records.

STREET LIGHTING. Mercury Vapor Lamps Banish "Diffused Darkness" of Old Street Lighting, S. B. Gaylord. *Elec. Light & Power*, vol. 17, no. 12, Dec. 1939, pp. 54–55 and 62. Modernization to conform with traffic safety standards is now possible with economy through use of new, high efficiency units which give double light per watt; various examples of existing installations; curve of utilization efficiency of mercury luminaire.

SEWERAGE AND SEWAGE DISPOSAL

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CHICAGO PLANT, OPERATION. Operating Problems in Starting Southwest Plant of Sanitary District of Chicago. *Sewage Works J.*, vol. 11, no. 6, Nov. 1939, pp. 1020–1037. Symposium including following: Introduction, A. H. Goodman; Treatment Problems, C. T. Mickle; Chemical Control, G. G. Poindexter; Mechanical Organization, R. C. Hageman.

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FUTURE TRENDS. Sewage Treatment Units Will Be Smaller and Mechanization Will Continue, J. B. Baty. *Eng. & Contract. Rec.*, vol. 52, no. 43, Oct. 25, 1939, pp. 19–23. Survey of trends in secondary sewage treatment, indicating that higher design rates are now being accepted and that future will see greater flexibility and reduced cost of operation and elimination of useless gadgets.

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INDUSTRIAL WASTE. Die Wiedergewinnung von Stoffen bei der Reinigung gewerblichen Abwassers, M. Pruess. *Gesundheits-Ingenieur*, vol. 62, no. 40, Oct. 7, 1939, pp. 587–590. Review of methods and equipment for utilization of industrial sewage by recovery of useful materials, such as copper from metallurgical plants, phenol from coal preparation plants, fats from woolen manufacturing plants, etc.

MANHOLES. Sewer Manholes and Chambers: Some Views on Design, L. B. Escritt. *Surveyor*, vol. 96, no. 2484, Sept. 1, 1939, pp. 223–227. Principles of design of brick and mass concrete manholes on small sewers; inverts and benchings; chambers and shafts; roof slabs; ironwork; precast concrete tube manholes; manholes on large sewers; back-drops, cascades, and water cushions; pressure manholes; bell mouth chambers and bends.

PLANTS, DETROIT, MICH. Detroit's Answer to 30-Year Pollution Problem, G. R. Thompson and A. B. Morrill. *Mun. Sanitation*, vol. 10, no. 11, Nov. 1939, pp. 533–538, 541–542, 545–546, 549–550, and 552. Detailed report on design, construction, and equipment of recently completed 1,300-mgd sewage disposal plant of Detroit, Mich.; features of sewage pumping station; bar racks and grit chambers; settling tanks; sludge collectors; sludge elutriation; vacuum filter equipment; gas engine; safeguard equipment; provisions for chlorination; plant control; sludge incinerators.

SEWAGE ANALYSIS. Interpretation of Sewage Tests, A. E. Berry and A. V. DeLaporte. *Can. Engr.*, vol. 77, no. 17, Oct. 24, 1939, pp. 34, 36, 38, 40, 42, and 44. Review of various laboratory examinations of sewage—how they are made, their relative value, and how they may be properly interpreted; advantages of Miller's method of determining dissolved oxygen; relative stability of effluents; determination of nitrogen; acidity, alkalinity, and pH value; bacterial analyses; solids and sewage loadings on plants.

SEWERS, OUTFALL. City's Sewage Goes to Sea—II, N. A. Bowers. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, pp. 82–84. Experience with subaqueous outfall sewers; design and construction features of underwater outfall sewers at White Point, Calif., Los Angeles, Calif., and Asbury Park, N.J.

WASTE UTILIZATION. Die Verwertung des Abwassers und des Schlammes, A. Heilmann. *Gesundheits-Ingenieur*, vol. 62, no. 41, Oct. 14, 1939, pp. 601–602. Brief review of modern methods of utilization of sewage for recovery of fertilizers, gas, fats, etc.

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DOMES, CONCRETE. Point-Supported Dome of Thin Shell Type, A. Tedesko. *Eng. News-Rec.*, vol. 123, no. 23, Dec. 7, 1939, pp. 85–86. Design and construction of point-supported concrete dome, 110 ft in diameter, recently erected over new auditorium at Tulane University, New Orleans; necessary stiffening at springline provided by polygonal set of diaphragms.

ROOF TRUSSES. Long Span Concrete Roof Trusses, W. S. Wilson. *Surveyor*, vol. 96, no. 2490, Sept. 13, 1939, pp. 327–329. Principles of design of long-span concrete roof trusses; numerical examples.

STRUTS. Determination of End-Constraint of Struts by Vibration Methods, H. A. Warren. *Instn. Civ. Engrs.—J.*, no. 1, Nov. 1939, pp. 49–62. Mathematical discussion of theory of transverse vibrations of struts modified and extended to conditions of elastic direction constraint and used as basis of experimental work, demonstrating means of evaluating elastic direction constraint by measurement of frequency of transverse vibrations when axial load is known; frequency of transverse vibrations; experimental work.

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ANTI-AIRCRAFT PROTECTION, SUBWAYS. Protective Works on Underground Railways. *Engineer*, vol. 168, no. 4377, Dec. 1, 1939, p. 542. Account of program of emergency works undertaken in conjunction with Ministry of Transport, by London Passenger Transport Board in order to protect its transport services from possible risks which might arise from air raids; one method of protection adopted in installation of floodgates at certain stations.

AQUEDUCTS. Some Notes on Construction of Aqueducts, J. D. Watson. *Engineer*, vol. 168, nos. 4369 and 4370, Oct. 6, 1939, pp. 344–346, and Oct. 13, pp. 368–370. Discussion of problems involved in open-cut work; excavation.

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VEHICULAR, ITALY. La Galleria sotto il Colle Gianicolense, L. Andreueci and U. Conte. *Strade*, vol. 21, no. 6, June 1939, pp. 281–288. Design and construction of vehicular tunnel under Gianicolense Hill, Rome, Italy, 296 m long, 16 m wide.

VEHICULAR, NEW YORK. New York's First Vehicle Tunnel Under East River. *Eng. News-Rec.*, vol. 123, no. 25, Dec. 21, 1939, pp. 52–55. Planning and designing of Queens-Midtown twin vehicular tunnels under East River, connecting boroughs of Queens and Manhattan, New York City; length of tunnels 7,400 ft and 7,865 ft; total cost over $58,000,000.

VEHICULAR, SWITZERLAND. Zum Problem der Autostrassentunnel, C. Andreae. *Schweizerische Bauzeitung*, vol. 114, nos. 1, 2, and 15, July 1, 1939, pp. 1–5; July 8, pp. 20–24; and Oct. 7, pp. 175–178. Results of investigation by special Swiss federal government commission on feasibility and economy of vehicular tunnels for Alpine region, with special reference to construction, ventilation, and lighting problems; estimates of costs of construction and maintenance of vehicular and railroad tunnels 2,000, 4,000, 6,000, and 7,000 m long. Bibliography.

WATER PIPE LINES

CONCRETE. New Type of Concrete Centrifugally Spun Pipe, C. J. Desbaillets. *Eng. & Contract. Rec.*, vol. 52, no. 41, Oct. 11, 1939, pp. 10–13 and 18–19. Review of evolution in design of concrete pipe leading to development of "superconcrete process"; advantages of centrifugally spun concrete pipe; process of manufacture and tests of "superconcrete" pipes; pipe joints; special fittings.

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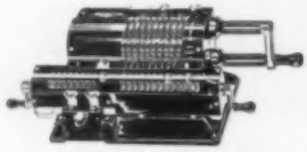

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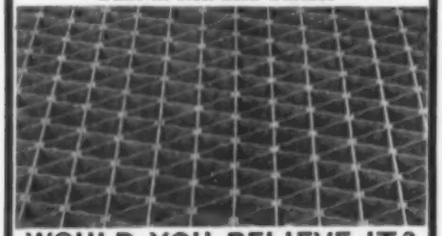

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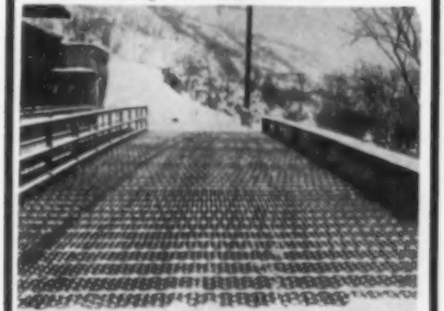

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CORROSION. Korrosionsschutz bei zentralen Warmwasserversorgungsanlagen, O. Kroehnke. *Gas- u. Wasserfach*, vol. 82, nos. 36 and 37, Sept. 9, 1939, pp. 641–647, and Sept. 16, 653–658. Discussion of engineering methods and chemical processes for reduction of corrosion in central hot water supply systems, which has become particularly urgent because of prohibition of use of copper in German hot water plants during current war; review of anti-corrosion water treatment processes; properties of comparatively non-corrosive pipe materials. Bibliography.

FLOW ANALYSIS. Nomographic Chart for Flow Analysis, H. Shand. *Can. Engr.*, vol. 76, no. 22, May 30, 1939, pp. 4–6. Construction of alignment chart for application of Hardy Cross method of determining flow distribution and loss of head in water supply networks.

MAINTENANCE AND REPAIR. Use of Arc-Welding in Reconditioning Pipe Lines, C. M. Taylor. *Petroleum Engr.*, vol. 11, no. 3, Dec. 1939, pp. 74, 76, and 78. Fill-in of pits when corroded area is small; half-soles of good pipe welded over large pitted areas, are accepted methods of repairing pipe; repair of oil pipe lines under pressure; oil lines repaired out of service; repair of gas pipe lines under pressure; repairing gas lines out of service; repair of gasoline pipe lines.

STEEL. New Method Developed for Placing Concrete Encasement on Steel Pipe. *Western Construction News*, vol. 14, no. 11, Nov. 1939, pp. 367–369. Description of method, developed by Vista Irrigation District in Southern California, for reclaiming and reconditioning of old steel pipe, used for irrigation distribution service, by encasing them in reinforced concrete cast in steel forms with aid of compressed air; field operations.

WATER HAMMER. Method of Calculating Water-Hammer Pressures, F. M. Dawson and A. A. Kalinske. *Am. Water Works Assn.—J.*, vol. 31, no. 11, Nov. 1939, pp. 1835–1864. Outline of general theory of water hammer and various simplified methods available for calculation of pressures caused by water hammer; calculating water hammer pressures under more complicated conditions encountered in fields; principles of graphical method of calculation; occurrence of water hammer in compound pipes, pump discharge lines, branched pipes, relief valves, and air chambers. Bibliography.

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UNDERGROUND, UNITED STATES. Water Levels and Artesian Pressure in Observation Wells in United States in 1938, O. E. Meinzer and L. K. Wenzel. *U.S. Geol. Survey—Water-Supply Paper 845*, 1939, 724 pp., 75 cents. Fourth of annual series on ground-water levels and artesian pressures observed in wells in 32 states and Territory of Hawaii that were obtained by U.S. Geological Survey and cooperating federal, state, territorial, county, and local agencies.

WATER TREATMENT

DRINKING WATER, FLUORINE CONTENT. New Knowledge of Fluorine in Relation to Dental Caries, G. J. Cox. *Am. Water Works Assn.—J.*, vol. 31, no. 11, Nov. 1939, pp. 1926–1930, (discussion) 1930. Review of several recent studies indicating that in some cities prevalence of dental caries is associated with lack of fluorine in public water supply; suggested methods of prophylaxis by correct fluoridization of water to prevent dental caries due to deficiency and mottled enamel due to excess of fluorine content of drinking water. Bibliography.

FILTRATION PLANTS, CONNECTICUT. Rapid Sand Filtration Plant for Willimantic, Connecticut, R. F. Kittredge. *New England Water Works Assn.—J.*, vol. 53, no. 3, Sept. 1939, pp. 328–336. Description of recently completed rapid sand filtration plant of Willimantic, Conn., serving population of 12,500; operating results.

FILTRATION PLANTS, POROUS PLATES. Porous Plate Filter Bottom, H. T. Hotchkiss, Jr. *Water Works & Sewerage*, vol. 86, no. 11, Nov. 1939, pp. 442–444. Satisfactory experience with false bottom of manufactured porous plates to support sand bed of filters of water treatment plant of Larchmont, N.Y. Bibliography.

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SEDIMENTATION. Application of Experimental Methods to Design of Clarifiers for Water Works, R. Walton and T. D. Key. *Instn. Civ. Engrs.—J.*, no. 1, Nov. 1939, pp. 21–48. Report on experimental study of sedimentation of principles of design of septic tanks conducted by water works of Alexandria, Egypt, during past 11 years; modifications based on results of investigation; results of modifications; design of model of settling tank; construction of two clarifiers each of 110-ft diameter, as enlarged replicas of 15-ft diameter experimental model.

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